

SELECTED



WATER

RESOURCES

ABSTRACTS



VOLUME 3, NUMBER 19
OCTOBER 1, 1970

Selected Water Resources Abstracts is published semimonthly for the Water Resources Scientific Information Center (WRSIC) by the Clearinghouse for Federal Scientific and Technical Information (CFSTI) of the Bureau of Standards, U. S. Department of Commerce. It is available to Federal agencies, contractors, or grantees in water resources upon request to: Manager, Water Resources Scientific Information Center, Office of Water Resources Research, U. S. Department of the Interior, Washington, D. C. 20240. Annual subscription is \$22.00 (domestic), \$27.50 (foreign), single copy price is \$3.00. Certain documents abstracted in this journal can be purchased from the Clearinghouse at the prices indicated in the entry. Prepayment is required.



U.S. Department of Commerce, Springfield, Va., 22151

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SELECTED WATER RESOURCES ABSTRACTS

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VOLUME 3, NUMBER 19
OCTOBER 1, 1970

W70-07649 -- W70-08148

As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States—now and in the future.

FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifiers which are listed in the **Water Resources Thesaurus** (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources. WRSIC is not presently prepared to furnish loan or retention copies of the publications announced.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas. Centers, and their subject coverage, now in operation are:

- Ground and surface water hydrology at the Water Resources Division of the U.S. Geological Survey, U.S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.

- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin, jointly sponsored by the FWPCA, Soap and Detergent Association, and the Agricultural Research Service.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.

In cooperation with the Federal Water Pollution Control Administration, the following "centers of competence" have been established:

- Thermal pollution at the Department of Sanitary and Water Resources Engineering of Vanderbilt University.
- Textile wastes pollution at the School of Textiles of North Carolina State University.
- Water quality requirements for freshwater and marine organisms at the College of Fisheries of the University of Washington.
- Wastewater treatment and management at the Center for Research in Water Resources of the University of Texas.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
Office of Water Resources Research
U.S. Department of the Interior
Washington, D. C. 20240

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Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Non-Water Activities; Watershed Protection.

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10 SCIENTIFIC AND TECHNICAL INFORMATION

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ABSTRACT SOURCES

SELECTED WATER RESOURCES ABSTRACTS

01. NATURE OF WATER

1B. Aqueous Solutions and Suspensions

A STUDY OF A SPECIFIC INFLUENCE OF DISSOLVED IONS ON THE STRUCTURE OF WATER,

Rocketdyne, Canoga Park, Calif.

J. Greyson, and H. Snell.

For sale by Superintendent of Documents, US Government Printing Office, Wash, DC 20402 - Price \$0.45. Office of Saline Water Research and Development Progress Report No 523, Jan 1970. 32 p, 7 fig, 4 tab, 33 ref. OSW Contract No 14-01-0001-1701.

Descriptors: *Water structure, *Ions, *Solutes, *Thermodynamic behavior, *Desalination processes, Thermodynamics, Water properties, Aqueous solutions, Water chemistry, Heavy water, Membrane processes.

Identifiers: Transfer properties, Transfer free energy.

Entropies of transfer between heavy and normal water for several multivalent cations and several polyatomic anions were determined from combination of heats of transfer obtained from calorimetric measurements with free energies of transfer obtained from cell measurements. The ions investigated included the alkaline earth cations, the group of aliphatic acid anions from the formate through the caproate, and the inorganic anions carbonate, nitrate, sulfate, and sulfite. The standard heat of transfer values for the alkaline earth chlorides and the sodium salts of the inorganic anions indicated an exothermic transfer for the process salt in heavy water to normal water. For the sodium salts of the aliphatic acid anions, the heat of transfer was negative for sodium formate, near zero for sodium propionate and butyrate, and positive for sodium caproate. Calculated entropy values followed the same pattern as the heats. The alkaline earth chlorides (with the exception of magnesium chloride) behave as structure-breaking salts. The structure influence and the concentration dependence of the entropies of transfer of the salts are explained in terms of the Gurney cosphere model. (Knapp-USGS)

W70-07651

STUDIES ON THE DECOMPOSITION OF ORGANIC DETRITUS DERIVED FROM THE TURTLE GRASS *THALASSIA TESTUDINUM*,

Miami Univ., Fla. Inst. of Marine Science.

Tom Fenchel.

Limnology and Oceanography, Vol 15, No 1, p 14-20, 1970. 5 fig, 16 ref.

Descriptors: *Decomposing organic matter, *Detritus, Biological communities, Oxygen, Bacteria, Diatoms, Amphipoda, Metabolism, Respiration, Ecosystems, Animals, Florida, Sampling, Algae, Nematodes, Fungi, Actinomycetes, Cyanophyta, Rotifers, Food chains, Sea water.

Identifiers: *Turtle grass, *Thalassia testudinum*, Ciliates, Parhyalella whelpleyi, Flagellates, Fecal pellets, Key Biscayne (Fla), Monas, Oikomonas, Tropidioscyphus, Entosiphon, Bodo, Rhynchomonas, Euplates, Aspidisca, Uronema marina, Cyathidium, Diophys, Hydrobia, Littonotus duplostriatus.

Measurements of metabolic rates do not always wholly depict a specific component's role. The quantitative composition of microbial communities living on detrital particles derived from turtle grass *Thalassia testudinum* was studied. Organism numbers on and rate of oxygen consumption of detritus are approximately proportional to total surface area. Field samples of detritus harbored about 3 billion bacteria, 50 million flagellates, 50,000 ciliates, and 20 million diatoms and consumed from 0.7 to 1.4 milligrams oxygen/hour per gram dry weight. The detritus-consuming amphipod *Par-*

yalella whelpleyi feeds on detrital particles and on its own fecal pellets but only uses the microorganisms; dead plant residue passes undigested through the intestine. After a few days microbial communities living on fecal pellets are qualitatively and quantitatively comparable to those living on other detrital particles. The amphipods decrease detritus particle size thereby increasing its total surface and thus the microbial activity. In less than four days, mechanical activity of amphipods may increase the detrital oxygen uptake by 110% of their own metabolic rate. Measurements of respiratory rates of the amphipods will therefore give a depressed estimate of their total role in the ecosystem. (Jones-Wisconsin)

W70-08109

The statistical parameters of precipitation and runoff, and the interrelations between corresponding parameters involve three processes: the input process (mean annual effective precipitation), the transformation process (basin storage), and the output process (mean annual runoff). The input is assumed to be a pure-random series, with known statistical parameters. The transformation is characterized by an exponential recession curve with one parameter. With these assumptions, equations are developed expressing the statistical parameters of the output for any length of carryover. The validity of these equations is confirmed by means of computer-simulated series, which are analyzed for their moments. The type of distribution of the output is also established. (Knapp-USGS)

W70-07905

02. WATER CYCLE

2A. General

WATER RESOURCES OF NEW MEXICO: OCCURRENCE, DEVELOPMENT, AND USE,

New Mexico State Engineer Office, and New Mexico Interstate Stream Commission.

For primary bibliographic entry see Field 06D.
W70-07786

THE ESTIMATION OF RUNOFF FROM RAINFALL FOR NEW BRUNSWICK WATERSHEDS,

Nelson Basin Board, Regina (Saskatchewan), and New Brunswick Univ., Fredericton. Dept. of Civil Engineering.

J. Lee, and D. I. Bray.

Journal of Hydrology, Vol 9, No 4, p 427-437, December 1969. 11 p, 1 fig, 3 tab, 11 ref.

Descriptors: *Rainfall-runoff relationships, *Statistical methods, Antecedent precipitation, Rainfall, Precipitation (Atmospheric), Regression analysis, Hydrograph analysis, Equations, Runoff forecasting, Depth-area-duration analysis, Infiltration.

Identifiers: *New Brunswick (Canada).

Prediction equations have been derived for forecasting runoff volume for regions within the Province of New Brunswick. Five basins were selected so as to provide a regionally representative distribution over the province. The prediction equations are based on the storm rainfall, antecedent precipitation index, base flow and week number in which the storm occurred. Statistical methods were used to obtain the least-squares multiple linear regression equation, correlation coefficient, and the standard error for each of the techniques used for the watersheds. The number of storms varied from 8 to 23 for the basins studied. The standard error of the optimum prediction equations for runoff ranged from 0.065 inches to 0.212 inches and the multiple correlation coefficient (*R*) varied from 0.556 to 0.963. The results of the regression equations developed for one basin were extended to a neighboring basin of similar hydrological characteristics but with only recent streamflow records. (Knapp-USGS)

W70-07904

RAINFALL-RUNOFF RELATIONSHIPS EXPRESSED BY DISTRIBUTION PARAMETERS,

Toronto Univ. (Ontario). Dept. of Civil Engineering.

Emil O. Frind.

Journal of Hydrology, Vol 9, No 4, p 405-426, December 1969. 22 p, 10 fig, 15 ref.

Descriptors: *Rainfall-runoff relationships, *Statistical models, Statistics, Parametric hydrology, Runoff forecasting, Recession curves, Simulation analysis, Synthetic hydrology, Mathematical models, Computer models, Probability, Stochastic processes.

Identifiers: Log normal distributions, Gamma distributions.

2B. Precipitation

AN INVESTIGATION OF CLOUDS AND PRECIPITATION FOR THE TEXAS HIGH PLAINS,

Texas Univ., Austin. Coll. of Engineering.

Donald R. Haragan.

Texas Water Development Board Report III, Mar 1970. 126 p, 30 fig, 18 tab, 25 ref, 4 append. Texas Water Development Board Grant IAC (68-69) - 175.

Descriptors: *Meteorology, *Synoptic analysis, *Texas, *Climatology, Clouds, Precipitation (Atmospheric), Droughts, Cloud seeding, Distribution patterns, Meteorological data, Weather data, Data collections.

Identifiers: High Plains (Texas).

A study of the relationship among cloudiness, precipitable water vapor, water vapor flux, stability and precipitation is presented for the Texas High Plains. A cloud census gives the annual and diurnal variations of cloud types and amounts in the area. The most common cloud types are altocumulus and cirrus. Total cloud cover is greatest during winter and least during fall. During periods of above normal rainfall, precipitation during late fall and winter is associated with stratiform clouds and cyclonic activity. Spring and summer precipitation is most highly correlated with cumuliform clouds. Periods of above normal precipitation in the plains area are associated with above normal cloud amounts, while dry periods are generally lacking in clouds. An exception is summer cumulus which occurs during both dry and wet periods. Wet periods are further characterized by atmospheric instability and above normal values of precipitable water vapor and water vapor transport. Dry periods are associated with atmospheric circulation patterns which either serve to cut off the supply of low-level moisture, produce subsidence and consequent atmospheric stability, or both. Occasionally, however, sufficient clouds are present during dry periods in conjunction with adequate supplies of precipitable water and the absence of upper level stability to hold promise for artificial cloud modification experiments. (Knapp-USGS)

W70-07655

THE DESIGN OF NOZZLE NETWORKS FOR THE SIMULATION OF RAINFALL,

Imperial Coll. of Science and Technology, London (England).

For primary bibliographic entry see Field 07A.

W70-07674

SOCIAL AND ECONOMIC IMPACT OF SNOW SURVEY DATA,

Soil Conservation Service, Boise, Idaho.

For primary bibliographic entry see Field 06B.

W70-07676

MONTANA TELEMETRY SYSTEM,

Soil Conservation Service, Bozeman, Mont.; and Montana State Univ., Bozeman. Dept. of Engineering.

Field 02—WATER CYCLE

Group 2B—Precipitation

For primary bibliographic entry see Field 07A.
W70-07678

A STUDY OF ARIDITY AND DROUGHTS AT VISAKHAPATNAM,
Andhra Univ., Waltair (India).
V. P. Subrahmanyam, and C. V. S. Sastri.
Annals of Arid Zone, Vol 8, No 1, p 18-22, Mar 1969. 5 fig, 2 tab, 4 ref.

Descriptors: *Water balance, *Droughts, *Arid climates, *Semi-arid climates, *Moisture deficit, Consumptive use, Hydrologic budget, Precipitation, Climatic data.

Identifiers: *India, *Aridity index.

Drought is a term of limited meaning involving a condition of water deficiency while aridity is a climatic term of wide connotation. The aridity index was developed for classification of climates and is the ratio of annual water deficit to annual water need. Yearly aridity indices for Visakhapatnam, India, were calculated for the years 1891-1965 according to a standard book-keeping procedure for water balance. The data indicate that drought intensities cannot be assessed purely on the basis of precipitation since water deficits do not necessarily vary with rainfall. It is concluded that disastrous droughts are the results not of total rainfall but of maldistribution of rainfall, and that drought duration is as crucial to water balance as drought intensity. (Casey-Arizona)

W70-07796

SOME ASPECTS OF WATER MANAGEMENT FOR CROP PRODUCTION IN ARID AND SEMIARID ZONE OF INDIA,
Central Arid Zone Research Inst., Jodhpur (India).
For primary bibliographic entry see Field 03F.

W70-07797

A HYDROMETEOROLOGICAL STUDY RELATED TO THE DISTRIBUTION OF PRECIPITATION AND RUNOFF OVER SMALL DRAINAGE BASINS - URBAN VERSUS RURAL AREAS,
Texas A and M Univ., College Station. Water Resources Inst.
For primary bibliographic entry see Field 04C.

W70-07980

THE CLIMATE OF CITIES,
William P. Lowry.
Scientific American, Vol. 217, No. 2, p. 15-24, August 1967. 14 fig.

Descriptors: *Precipitation (Atmospheric), *Air temperature, *Climates, Fog, Smoke, Humidity, Absorption, Solar radiation, Cloud cover.
Identifiers: *Heat island, *Dust dome, Infrared photography, Thermograph.

The five basic reasons for the variations in climate between the cities and the countryside included: (1) Greater absorption of heat energy by surface materials in the city than in the countryside; (2) The greater variation in shapes and orientation of structures; (3) Increased number of particulates in the air above the city; (4) Extra generation of heat in the city; and (5) Distinctly different ways of disposing of precipitation, leading to less cooling. These basic influences apply to a city during the course of a day. As the sun comes up, slow circulation of air between the city and the suburbs occurs due to the reflection of rays and absorption of heat caused by the walls in the city. At midday little difference in temperature could be detected between the city and the suburbs. In the late afternoon, however, a marked difference was observed. At night, the suburbs cooled more rapidly. Other observed characteristics of the city included a 'dust dome,' a heat island, loss of sunlight, frequency of fogs, and increased precipitation. In summary, the variables of climate are profoundly affected by the physical characteristics and human activities of a city. Those living in the city have lower heating bills,

fewer days with snow, and a longer gardening season. (Osborne-Vanderbilt)
W70-08121

MODELS OF PRECIPITATING CUMULUS TOWERS,

Environmental Science Services Administration, Miami, Fla. Atmospheric Physics and Chemistry Lab.

For primary bibliographic entry see Field 03B.
W70-08124

RECENT STUDIES OF URBAN EFFECTS ON PRECIPITATION IN THE UNITED STATES,

Illinois State Water Survey, Urbana.
For primary bibliographic entry see Field 04C.
W70-08126

MOISTURE POLLUTION OF THE ATMOSPHERE BY COOLING TOWERS AND COOLING PONDS,

Oregon State Univ., Corvallis. Dept. of Atmospheric Sciences.

For primary bibliographic entry see Field 05C.
W70-08128

2C. Snow, Ice, and Frost

FALLOUT AND CLIMATE STUDIES ON FIRN CORES FROM CARREFOUR, GREENLAND,

Innsbruck Univ. (Austria); and Copenhagen Univ. (Denmark). H. C. Orsted Inst.

For primary bibliographic entry see Field 05A.
W70-07667

2D. Evaporation and Transpiration

PRESENT DAY EVAPORATION MEASUREMENT TECHNIQUES,

Geological Survey, Denver, Colo.

G. Earl Harbeck, Jr., and J. Stuart Meyers.
ASCE Proceedings, Journal of the Hydraulics Division, Vol 96, No HY7, Paper 7388, p 1381-1390, July 1970. 10 p, 2 fig, 1 tab, 14 ref, append.

Descriptors: *Reservoir evaporation, *Reservoirs, *Mass transfer, *Energy budget, Solar radiation, Water measurement, Costs, Evaporation, Water loss.

Identifiers: Falcon Reservoir (US-Mexico).

The energy-budget and mass-transfer methods are currently being used by the U.S. Geological Survey to measure evaporation from lakes and reservoirs. Because the field equipment is expensive and data processing and analysis are time consuming, the use of the energy-budget method is limited to those reservoirs where the need for detailed information warrants the expense. Ordinarily the mass-transfer coefficient for a selected reservoir is determined using the energy-budget method over a period of 15 months or longer. After this, the energy-budget equipment can be removed, and the mass-transfer method, which requires a minimum of equipment and office work, can be used to compute evaporation on a continuing basis. During 1965-67 a cooperative study by the International Boundary and Water Commission and the Geological Survey showed that evaporation from Falcon Reservoir on the Rio Grande was 189 cm and 167 cm for two successive years. (Knapp-USGS)

GENERAL CIRCULATION OF WATER MASSES IN THE RED SEA,

Woods Hole Oceanographic Institution, Mass.

G. Siedler.

In: *Hot Brines and Recent Heavy Metal Deposits in the Red Sea*; published by Springer-Verlag New York Inc, p 131-137, 1969. 7 p, 7 fig, 32 ref.

Descriptors: *Currents (Water), *Salinity, Density currents, Evaporation, Water temperature, Winds, Oceanography, Mapping, Climates, Arid lands.
Identifiers: *Red Sea.

A summary is given of the main features of the Red Sea circulation caused by evaporation and wind stress. Average temperature and salinity distributions are discussed, and some estimates of the water budget and water renewal times are calculated. (See also W70-07394). (Knapp-USGS)
W70-07684

EVAPORATION, POTENTIAL EVAPOTRANSPIRATION IN LEBANON, AND CALCULATED PICHE COEFFICIENT (IN FRENCH),

Food and Agriculture Organization of the United Nations, Tal-Amara (Lebanon); and Lebanon Agricultural Research Inst., Tal-Amara. Dept. of Irrigation Engineering.

S. Sarraf, N. Vink, and A. Aboukhaled.
English summary. *Magnon, Serie Scientifique*, Publication No 32, Dec 1969. 29 p, 6 fig, 5 tab, 4 append.

Descriptors: *Evaporation, *Evapotranspiration, Climatology, Irrigation, Irrigation effects, Lysimeters, Microenvironment, Evaporation pans, Arid lands, Semi-arid climates.

Identifiers: *Potential evapotranspiration, *Lebanon.

Evaporation and potential evapotranspiration (PET) data were reported for the Coastal Plain and Central Bekaa Valley of Lebanon over the years 1966-1969. Evaporation and PET were measured at two stations in each area: Tal-Amara and Terbol (Central Bekaa) and Abde and Tyr (Coastal Plain). PET values were obtained in the Central Bekaa through the use of 4 square-meter and 0.26 square-meter drainage lysimeters. On a monthly basis, PET agreement between the two lysimeter sizes was good. Measured PET values from Tal-Amara exceeded those from Terbol by 10%. This was probably due to lack of irrigation near Tal-Amara as compared to extensive irrigation near Terbol. During the April-September irrigation seasons in 1968 and 1969, evaporation in the Central Bekaa exceeded evaporation on the Coast by 16% (calculated by the Penman method), 23% (sunken Colorado pan), and 33% (class A pan). For this same period measured PET was approximately 1100 mm in the Central Bekaa and 800 mm on the Coast. The authors suggested using a seasonal alpha coefficient (Bouchet formula) of 0.34 for the Lebanese Coast and 0.26 for the irrigated lands in the Central Bekaa Valley. (Carr-Arizona)

W70-07768

A GENERALISED COMPUTER PROGRAM FOR THE SOLUTION OF THE PENMAN EQUATION FOR EVAPOTRANSPIRATION,

Aston Univ., Birmingham (England).
Thomas R E. Chidley, and John G. Pike.

Journal of Hydrology, Vol 10, No 1, p 75-89, Jan 1970. 15 p, 1 tab, 6 ref, 5 append.

Descriptors: *Evapotranspiration, *Consumptive use, Meteorological data, *Solutions, *Computer programs, *Computer programming, Hydrology.
Identifiers: *Penman equation, Potential evaporation, ALGOL, Water budget.

A generalized computer program that has a wide application with regard to location and variety of input data is given for solving the Penman equation for evapotranspiration. The form of output is designed to provide an immediate record of potential evaporation rates and a summary of the meteorological data used. The main elements of the Penman equation are in self-contained blocks, enabling changes to be made in some of the sections of the program to allow for more advanced methods. Possible lines of development of this program are: (1) More sophisticated procedures for computing the saturation vapor pressure and the slope of the saturation vapor pressure for differing

conditions. The formulas used in the program apply only to conditions over water at normal pressure. (2) From the point where the program begins to substitute the time-averaged data into the Penman equation, the whole program, excluding output, could be written as an ALGOL procedure, enabling the formula to be more readily incorporated within the body of other programs, such as water budget problems. (3) The aerodynamic term could be modified to include a wind term based on wind profile theory incorporating surface roughness to give more reliable estimates for short time periods. (USBR)
W70-07877

FOREST HYDROLOGY IN A KARSTIC REGION OF SOUTHERN AUSTRALIA, Commonwealth Scientific and Industrial Research Organization, Adelaide (Australia). Div. of Soils.

J. W. Holmes, and J. S. Colville.

Journal of Hydrology, Vol 10, No 1, p 59-74,

January 1970. 16 p, 9 fig, 3 tab, 4 ref.

Descriptors: *Evaporation, *Forests, *Pine trees, *Water balance, Solar radiation, Rainfall, Infiltration, Soil water, Groundwater, Water table, Recharge, Water level fluctuations, Water utilization, Consumptive use, Demonstration watersheds.
Identifiers: *Australia, Gambier Plain.

Evaporation was measured in two stands of *Pinus radiata* in southern Australia at a location of 141 deg E, 38 deg S. The predominantly winter rainfall of about 600 mm was almost all evaporated by early summer and therefore no recharge of the local aquifer, by deep infiltration, occurred beneath the forest. The evaporation from forest during winter and spring was up to 2.2 times that from grassland. There was no soil water stress during this period but an explanation is needed for the supply of energy used in forest evaporation. The forest albedo is less than that of the pasture but the extra radiation energy absorbed by the forest is insufficient to explain all the increase of evaporation. Advection of sensible heat from the neighboring grassland is sometimes sufficient to explain the greater evaporation from the forests. It is thought that subsidence of continental air masses supplies an appreciable component of the energy budget. Also, advection from the Southern Ocean may supply energy to this part of southern Australia during winter and early spring. (Knapp-USGS)
W70-07901

GRASSLAND HYDROLOGY IN A KARSTIC REGION OF SOUTHERN AUSTRALIA, Commonwealth Scientific and Industrial Research Organization, Adelaide (Australia). Div. of Soils.

J. W. Holmes, and J. S. Colville.

Journal of Hydrology, Vol 10, No 1, p 38-58,
January 1970. 21 p, 11 fig, 4 tab, 11 ref.

Descriptors: *Water requirements, *Irrigation water, *Hydrologic budget, *Grasslands, *Karst, Recharge, Evapotranspiration, Groundwater, Water table, Lysimeters, Nuclear moisture meters, Rainfall, Water utilization, Consumptive use, Water balance.
Identifiers: *Australia, Gambier Plain.

The water balance of grassland on the Gambier Plain, Australia, about 24 miles from the Southern Ocean, was investigated using lysimeters and neutron moisture meters. For the years 1961-1965, precipitation was 632 mm, evaporation was 588 mm, and underground drainage to a water table aquifer in Tertiary limestone was 63 mm. The balance item of -19 mm represents change in soil water content. The total recharge of the groundwater was estimated to be about 430,000 acre-feet per year from an area of 3 million hectares. The irrigation potential was assessed to be about 150,000 ha, from the annual recharge of the groundwater resource. In the highest rainfall region which has an area of 350,000 ha, about one quarter of the land could be irrigated by local groundwater. (Knapp-USGS)
W70-07902

ENVIRONMENTAL EFFECTS OF NUCLEAR COOLING FACILITIES,
Oregon State Univ., Corvallis. Dept. of Atmospheric Sciences.
For primary bibliographic entry see Field 05C.
W70-08125

2E. Streamflow and Runoff

FREE SURFACE, VELOCITY GRADIENT FLOW PAST HEMISPHERE,
Utah State Univ., Logan. Dept. of Hydraulic Engineering; Colorado State Univ., Fort Collins. Dept. of Civil Engineering; and North Dakota Univ., Grand Forks. Dept. of Civil Engineering.
For primary bibliographic entry see Field 08B.
W70-07657

FLOW ANALYSIS OF LARGE TRIANGULAR WEIR,
Agricultural Research Service, Chickasha, Okla.
For primary bibliographic entry see Field 07B.
W70-07660

EFFICIENCY OF AIR-ENTRAINING VORTEX FORMATION AT WATER INTAKE,
British Columbia Univ., Vancouver. Dept. of Civil Engineering.
For primary bibliographic entry see Field 08B.
W70-07662

INCEPTION AND ENTRAINMENT IN SELF-AERATED FLOWS,
Indian Inst. of Science, Bangalore. Dept. of Civil and Hydraulic Engineering.
For primary bibliographic entry see Field 08B.
W70-07670

EXPERIMENT ON AN EFFLUENT DISCHARGING FROM A SLOT INTO STATIONARY OR SLOW MOVING FLUID OF GREATER DENSITY,
Hydraulics Research Station, Wallingford (England).
For primary bibliographic entry see Field 08B.
W70-07672

STREAMFLOW FORECASTING, A VITAL ELEMENT IN WATER MANAGEMENT,
Bureau of Reclamation, Salt Lake City, Utah.
For primary bibliographic entry see Field 07B.
W70-07677

TRANSIENT AND ASYMPTOTIC BEHAVIOUR OF RESERVOIRS WITH NON-PERSISTENT SEASONAL INFLOWS,
Lancaster Univ., Bailrigg (England).
E. H. Lloyd.
Journal of Hydrology, Vol 10, No 3, p 243-258,
April 1970. 16 p, 6 ref.

Descriptors: *Reservoir storage, *Mathematical models, *Stochastic processes, *Statistical models, Streamflow forecasting, Statistics, Reservoir yield, Reservoir operation, Markov processes.
Identifiers: Reservoir forecasting, Reservoir management.

A mathematical model for a reservoir system comprises stochastic inflow, storage, and outflow. It has been shown that, when one approximates the continuum of water quantity by discrete units, and continuous time by discrete epochs, the sequence of statistically independent inflows gives rise to a Markovian sequence of reservoir contents. A complete solution contains a time-dependent ('transient') term, involving the initial configuration of the reservoir, as well as a constant ('asymptotic') component, which is independent of the initial conditions. In order to facilitate the solution, the Langbein model has been further simplified by coarsening the subdivision of the reservoir to only three

states - empty, half-full and completely full. (Knapp-USGS)
W70-07898

THE ESTIMATION OF RUNOFF FROM RAINFALL FOR NEW BRUNSWICK WATERSHEDS,
Nelson Basin Board, Regina (Saskatchewan); and New Brunswick Univ., Fredericton. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02A.
W70-07904

RAINFALL-RUNOFF RELATIONSHIPS EXPRESSED BY DISTRIBUTION PARAMETERS,
Toronto Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 02A.
W70-07905

A HYDROMETEOROLOGICAL STUDY RELATED TO THE DISTRIBUTION OF PRECIPITATION AND RUNOFF OVER SMALL DRAINAGE BASINS - URBAN VERSUS RURAL AREAS,
Texas A and M Univ., College Station. Water Resources Inst.
For primary bibliographic entry see Field 04C.
W70-07980

2F. Groundwater

DYNAMICS OF AN ARIZONA TRAVERTINE-FORMING STREAM,
Arizona State Univ., Tempe.
Gerald A. Cole, and George L. Batchelder.
Journal of the Arizona Academy of Sciences, Vol 5, No 4, p 271-283, October 1968. 3 fig, 6 tab, 40 ref.

Descriptors: *Travertine, *Calcium carbonate, *Discharge measurements, *Surface-groundwater relationships, *Carbon dioxide, Calcite, Calcium compounds, Hardness (Water), Alkalinity, Hydrogen ion concentration, Water properties, Oxygen, Cations, Anions, Magnesium, Arizona.
Identifiers: *Limnocrene environments, *Montezuma well, Oxygen productivity, Total equivalents.

Waters leaving a limnocrene environment, Montezuma Well, Yavapai County, Arizona, were studied at 3 successive stations downstream from the well outlet in June and December, 1968. In all instances there was a loss of total milliequivalents of principal ions per liter between stations I-III and II-III and a slight gain between stations I-II. Computed oxygen productivity was considered comparable to most eutrophic waters. About 90 percent of the free carbon dioxide was lost from the outlet to station III, in June, amounting to an average of 1.0 to 1.7 mg/liter/minute. In October the range was 1.6-1.7 mg/liter/minute. At stations II and III, the pH increased with carbon dioxide losses, amounting to 0.72 and 0.23 units in June and 0.76 and 0.07 units in October. It was speculated that the free carbon dioxide content in incoming waters may be highly variable. Cl, Na, K, Mg and sulfate ions were constant at all stations. Microparticulate calcium carbonate caused differences in alkalinity and hardness figures, and a mean of 88.8 kilograms per day of calcium carbonate was deposited between stations II and III, or about 4 percent of the amount in the flow per hour. (Casey - Arizona)
W70-07781

GRASSLAND HYDROLOGY IN A KARSTIC REGION OF SOUTHERN AUSTRALIA,
Commonwealth Scientific and Industrial Research Organization, Adelaide (Australia). Div. of Soils.
For primary bibliographic entry see Field 02D.
W70-07902

Field 02—WATER CYCLE

Group 2F—Groundwater

RELATION OF SEA WATER TO FRESH WATER IN CARBONATE ROCKS IN COASTAL AREAS, WITH SPECIAL REFERENCE TO FLORIDA, U.S.A., AND CEPHALONIA (KEPHALLINIA), GREECE,
Geological Survey, Washington, D.C.
V. T. Stringfield, and H. E. LeGrand.
Journal of Hydrology, Vol 9, No 4, p 387-404, December 1969. 18 p, 9 fig, 18 ref.

Descriptors: *Groundwater movement, *Saline water intrusion, *Karst, *Florida, Aquifers, Salinity, Sea water, Saline water systems, Sinks, Springs, Lakes, Density, Water circulation, Hydrogeology.
Identifiers: Cephalonia (Greece).

The principles controlling the equilibrium between the denser salty water and the lighter fresh water in coastal aquifers apply to carbonate as well as sand systems. However, under certain equilibrium conditions of fresh and salt water in parts of some carbonate aquifers unusual hydrologic phenomena result. Hydrologic conditions at Tarpon Springs, Florida, and Cephalonia, Greece, include deep vertical openings as sinkholes through a relatively impervious part of the aquifer system. In both cases the tops of the sinkholes or natural wells are exposed to sea water. At Tarpon Springs the dynamic equilibrium between salt water and fresh water fluctuates so that the flow of salt water from the spring to a lake 2 miles away is sometimes reversed. At Cephalonia, the head of fresh water does not exceed the head of salty water in the sinkholes; the flow of sea water into the aquifer, aided by a shallow channel from the sea, is continuous, and the water level in the sinkhole is continuously depressed below sea level. Both cases represent a partially confined U-tube system where water at the seaward, sinkhole end is denser than at the other end and where a low fresh-water head is less than the salt-water head. (Knapp-USGS)
W70-07906

U-234/U-238 DISEQUILIBRIUM AS AN AID TO HYDROLOGIC STUDY OF THE FLORIDAN AQUIFER,
Florida State Univ., Tallahassee. Dept. of Geology.
M. I. Kaufman, H. S. Rydell, and J. K. Osmond.
Journal of Hydrology, Vol 9, No 4, p 374-386, December 1969. 13 p, 7 fig, 1 tab, 23 ref. Project A-005-FLA.

Descriptors: *Tracking techniques, *Groundwater, *Florida, *Uranium radioisotopes, Tracers, Karst, Aquifers, Hydrogeology, Radioactivity techniques, Permeability, Groundwater movement, Water chemistry, Trace elements.
Identifiers: Floridan aquifer.

Investigation of the distribution and environmental disequilibrium patterns of naturally occurring uranium isotopes (U-234, U-238) in waters of the Floridan aquifer in north Florida, utilizing the analytical methods of isotope dilution and alpha-particle spectrometry, indicates that variations in isotopic activity ratios and concentrations are related to the regional hydrogeologic framework. Interpretation is possible in terms of regional permeability characteristics including the existence of hydrologic barriers, groundwater circulation patterns, sources of waters from various parts of the hydrologic environment, and areas of extensive Pleistocene leaching within the Floridan aquifer. (Knapp-USGS)
W70-07907

2G. Water in Soils

CHANGES IN SOIL NUTRIENT STATUS RESULTING FROM OVERGRAZING AND THEIR CONSEQUENCES IN PLANT COMMUNITIES OF SEMI-ARID AREAS,
University of New England, Armidale (Australia).
Dept. of Botany.
J. L. Charley, and S. W. Cowling.
Proceedings of the Ecological Society of Australia, Vol 3, p 28-38, 1968. 3 fig, 6 tab, 30 ref.

Descriptors: *Desert plants, *Cycling nutrients, *Essential nutrients, *Organic matter, Nitrogen, Phosphorus, On-site data collection, Soil-water-plant relationships, Nutrient requirements, Erosion, Arid lands, Biomass, Annual turnover, Productivity, Degradation (Decomposition).
Identifiers: *Australia, Degraded areas.

It is argued that limitation of essential nutrients and not water are the limiting factors in plant biomass in arid regions. Nitrogen content in the soil is largely a function of nodulating legumes and input is limited by active plant growth. Arid regions have less N than humid regions and Australia has less than other arid regions. Soil organic matter is low in deserts because sparse rainfall limits decay periods. Soil phosphorus is little affected by climatic factors or natural input and is mainly governed by the P content of parent material. Soils at the lower end of the fertility spectrum show the greatest relative accumulation of nutrients near the surface and organic carbon, total N and available P and nitrate production fall away sharply with increasing depth. Measurements in a saltbush community showed that the total leaf and fruit litter fall for a year was greater than the weight of leaf held in the community, indicating a high recycling rate. In an overgrazed area with a soil truncation to 10 cm due to erosion it was estimated that 35% of total circulating N, 45% of organic matter and greater than 22% of an already low P is lost. Efforts to furrow the area and eliminate grazing did not increase plant production. It was concluded that probably not lack of rainfall but low P limited N production and the whole system of nutrients is delicately balanced by a high recycling process which is easily disturbed. (Casey-Arizona)
W70-07761

HYDRAULIC CONDUCTIVITY AND CERTAIN SOIL CHARACTERISTICS OF SUBSOILS WITH SPECIAL REFERENCE TO DRAINAGE DESIGN IN THE ALLUVIAL SOILS OF U.A.R.,
Ain Shams Univ., Cairo (Egypt). Dept. of Soils.
Hassan Hamdi, Salah El Din Metwally, and Bishay Guindi.
Journal of Soil Science of the U.A.R., Vol 8, No 1, p 51-70, 1968. 4 tab, 13 ref.

Descriptors: *Hydraulic conductivity, *Drainage, *Groundwater movement, *Permeability, *Soil texture, Compaction, Fractures (Geology), Alluvium, Anion exchange, Cation adsorption, Electrical conductivity, Clays, Fine-textured soils, Sediments, Impermeability, On-site tests, Drilling, Soil surveys, Soil chemical properties, Soil physical properties, Drains, Data collections.
Identifiers: United Arab Republic.

The proper orientation and placement of drains relative to the most permeable layers of the soil profile is considered a function of hydraulic conductivity. Previously the hydraulic conductivities of alluvial soil in the U.A.R. were determined by studying soil texture. This study utilized the auger hole method, below the water table, to determine relationships between hydraulic conductivity and various soil characteristics: electrical conductivity, soluble anions, SAR, and exchangeable cations. None were found. Additionally, no apparent relationships between hydraulic conductivity and various textural fractions could be established. It was concluded that the hydraulic conductivity, for a given soil volume, is a function of various passageways for water, such as cleavages and fissures. These channels cannot be determined by textural analyses and it is therefore inadvisable to use textural characteristics alone as a criterion for drain spacing. Also, impermeable layers are probably the result of some interaction between: (1) A high percentage of fine clay combining with the high water table, causing stratification, and (2) Compression of deep layers by overlying surface layers resulting in less aeration. (Casey-Arizona)
W70-07762

CONTROL OF SOIL MOISTURE DURING SPRINKLER IRRIGATION,
Utah State Univ., Logan. Dept. of Agricultural and Irrigation Engineering.
For primary bibliographic entry see Field 03F.
W70-07769

MICROBIOLOGICAL PROBLEMS OF THE ARID ZONE,
Cornell Univ., Ithaca, N.Y. Lab. of Soil Microbiology.
For primary bibliographic entry see Field 03F.
W70-07779

THE ASSESSMENT OF SOIL WATER STATUS AS IT AFFECTS PLANT WATER USE,
National Vegetable Research Station, Wellesbourne (England).
For primary bibliographic entry see Field 02I.
W70-07799

THE QUANTITATIVE DESCRIPTION OF SOIL MOISTURE STATES IN NATURAL HABITATS WITH SPECIAL REFERENCE TO MOIST SOILS,
University Coll. of Wales, Aberystwyth.
V. I. Stewart, and W. A. Adams.
Measurement of Environmental Factors in Terrestrial Ecology, Blackwell Scientific Publications, p 161-173, 1968. 1 fig, 3 tab, 6 ref.

Descriptors: *Drainage, *Moisture content, *Soil water, *Porosity, *Soil moisture, Field capacity, Soil profiles, Soil horizons, Soil properties, Soil investigations, Soil water movements, Sampling, Pore sizes, Cores, Retention.
Identifiers: *pF values, *Waterlogged percentage, *Drainage state, *Gley characters, *Soil wetness measures, Sampling depth, Intact field cores, Soil retentivity, Moisture release curve, Site characteristics.

Pedologists assess drainage state on the basis of gley characters which are unsupported by any quantitative evidence relating significance for drainage to actual moisture states. In an effort to express difference in degree of soil wetness on an understandable comparative basis, several techniques are considered: (1) The most appropriate sampling occasions; (2) Measurement locale; (3) Sampling types; (4) Relevant concepts of wetness and the consequent required type of measurement. Sampling should be restricted to field capacity days and samples should be compared to standard samples from freely drained soil. Sampling should also be confined to clearly defined described horizons from which intact field cores of known volume are taken. Percentage pore space filled with water is considered the best parameter of soil wetness and should be described as 'percent waterlogged'. The pF value as a measure of soil moisture states is discussed and it is recommended that field cores be equilibrated at pF2 and weighed. A graph of percent waterlogged on field capacity day versus percent waterlogged at pF 2 then facilitates a distinction between horizons poorly drained because of site and horizons probably waterlogged because of retentivity. (Casey-Arizona)
W70-07800

COMPARISON OF METHODS FOR CALCULATING VERTICAL DRAINAGE AND INFILTRATION FOR SOILS,
Agricultural Research Service, Phoenix, Ariz.
Frank D. Whisler, and Herman Bouwer.
Journal of Hydrology, Vol 10, No 1, p 1-19, Jan 1970. 19 p, 13 fig, 1 tab, 20 ref.

Descriptors: *Drainage, *Infiltration, *Soils, Capillary conductivity, Soil water movement, Numerical analysis, Numerical method, Methodology, Equations, Porous media, Capillary tubes, Groundwater flow, Unsaturated flow, Hydraulic conductivity, Saturated flow, Bibliographies, Drainage engineering, Moisture uptake, Theoretical analysis.

Identifiers: *Comparative studies, Infiltration rate, Soil columns, Water absorption tests, Permeability tests.

The Youngs, Gardner, Ligon, and numerical analysis techniques for calculating the amounts of one-dimensional, vertical drainage from soil are discussed and compared with each other and with observed data. The same was done with the Green and Amt, Philip, and numerical analysis methods for calculating the amounts of infiltration into soil profiles. The numerical analysis methods gave the best agreement with the observations, but required considerable input data, and the calculation procedure was not simple. The Youngs drainage equation and the Green and Amt infiltration equation were the easiest to use, giving reasonably accurate results that are probably sufficient for most field problems. (USBR)

W70-07876

HYSTERESIS OF PORE WATER IN GRANULAR POROUS BODIES,

Agricultural Research Council, Cambridge (England).

A. Poulovassilis.

Soil Sciences, Vol 109, No 1, p 5-12, Jan 1970. 8 p, 10 fig, 1 tab, 5 ref.

Descriptors: *Hysteresis, *Porous materials, *Porous media, Wetting, *Granular materials, Sands, Hydraulic conductivity, Moisture content, Drying, Soil science, Soil engineering, Forecasting, Laboratory tests.

Identifiers: Suction, *Pore water, Soil columns, Soil suction.

Experimental results concerning the hysteresis behavior of granular porous bodies are compared with the predictions of the independent domain concept. A dynamic method is described for the direct determination of the relationships between moisture content and suction and moisture content and hydraulic conductivity on long vertical columns. Some experimental results concerning the hysteresis of the hydraulic conductivity are reported. To achieve the desired results, it was necessary to devise a method of stabilizing the geometry of a granular porous body, over long periods and over many reversals of wetting and drying, more generally applicable than in sintering. The method adopted was to work with deep columns of material and to stabilize the geometry by overburden pressure. (USBR)

W70-07878

2H. Lakes

STRATIFICATION OF FLOW FROM CHANNEL INTO DEEP LAKE,

Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.

Heinz Stefan.

ASCE Proceedings, Journal of the Hydraulics Division, Vol 96, No HY7, Paper 7401, p 1417-1434, July 1970. 18 p, 10 fig, 8 ref, append.

Descriptors: *Stratified flow, *Heated water, *Thermal powerplants, *Outlets, *Hydraulic models, Thermal pollution, Lakes, Oceans, Model studies, Discharge (Water), Thermal stratification, Density stratification, Outlet works, Cooling water, Open channel flow, Reservoirs, Water temperature, Water quality, Water quality control, Water pollution control.

Identifiers: Thermal discharges.

The flow of heated water from an open channel into a reservoir containing colder and essentially stagnant water was studied in a laboratory flume. The basic mechanisms studied can produce a variety of substantially different flow patterns. The combined effects of buoyancy, viscosity, and stratification conditions in the reservoir on the flow are shown qualitatively in the case of a two-layered system. The information obtained may be used to design and operate heated water outlets and outfalls in lakes and oceans. (Knapp-USGS)

W70-07661

SIZE OF CENTRIC DIATOMS AS AN ECOLOGICAL INDICATOR,

Instituto de Investigaciones Pesqueras, Barcelona (Spain).

Ramon Margalef.

Mitteilungen Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Vol 17, p 202-210, 1969. 4 fig, 1 tab, 16 ref.

Descriptors: *Diatoms, *Ecology, *Indicators, *Lakes, Size, Temperature, Salinity, Nutrients, Sediments, Seasonal, Zooplankton, Environmental effects.

Identifiers: *Centric diatoms, Skeletonema, Melosira arenaria, Melosira sulcata, Italy, Vigo Bay (Spain), Polyomorphic, Coscinodiscus nodulifer, Woods Hole (Mass), Pyrenees, Fossil lake, Cyclotella bodanica, Stephanodiscus, Cyclotella comensis, Fragilaria crotonensis, Lake Maggiore (Italy), Lake Mergozzo (Italy), Size fluctuations.

Some published information is reviewed and new evidence presented concerning diatoms of the Italian lakes. Distribution of Melosira sulcata suggests that environmental influence on populations may act through differential selection of discrete morphs and through phenogenetic reaction of the cells in each morph. The data from Vigo Bay (Spain) suggest that salinity influences size of Melosira sulcata, and, under lowered salinity, higher diameters are more common. Nutrient concentration is probably also relevant. Observation of present and past sediments point to association between larger diameter of frustules and highly productive water in recent sediments, or a higher content of plant pigments in older ones. A large species of Stephanodiscus was common in certain periods of the lake's existence and exhibited, like other diatoms, insignificant differences in the average diameter. It is tentatively suggested that a notable fluctuation in size may be due to seasonal changes in water temperature and that, as today, frustules sedimented in summer are on the average thinner than those deposited in colder seasons. Specimens of Cyclotella bodanica were measured from two small cores of sediment from Lago Maggiore and Lago di Mergozzo suitable for checking changes of size with time. (Jones-Wisconsin)

W70-08099

AQUATIC PLANT SURVEY OF MAJOR LAKES IN THE MILWAUKEE RIVER WATERSHED,

Wisconsin Dept. of Natural Resources, Madison.

Richard F. Modlin.

Department of Natural Resources, Madison, Wisconsin, Research Report No 52, 1970. 45 p, 1 fig, 4 tab, 10 ref, 17 photos.

Descriptors: *Aquatic plants, *Surveys, *Lakes, *Wisconsin, Watersheds (Basins), Chara, Cattails, Bulrush, Sago pondweed, Sampling, Water quality, Geographical regions, Geology, Limnology, Bottom sediments, Fertility, Weed control.

Identifiers: *Milwaukee River (Wis), Typha, Scirpus validus, Potamogeton pectinatus, Nymphaea tuberosa, Chara, Nuisance growths, Myriophyllum, Sagittaria, Anacharis, Najas, Lemna, Eleocharis, Carex, Ceratophyllum, Cyperus, Sparganium, Acorus, Asolepias, Brasenia, Caltha, Decodon, Equisetum.

Twenty-three lakes of the Milwaukee River watershed were surveyed from June to September 1968, to record aquatic vegetation abundance and species composition; 39 genera and 61 species were identified. The greatest variety recorded in any single lake was 24 genera and 34 species. Stonewort (Chara), cattail (Typha), softstem bulrush (Scirpus validus), sago pondweed (Potamogeton pectinatus), and white water lily (Nymphaea tuberosa) occurred most extensively and in greatest abundance. Some variations in abundance and dominance were noticed over the summer. Marl lakes of the northeast basin and the tea-colored lakes of the northwest basin contained a very small biomass and scattered plant distribu-

tion, while the other lakes had a very large biomass and continuous distribution of plants. The importance of lake vegetation cannot be minimized but overabundance of any species will interfere with lake usage. Enrichment, pollution, and other unnatural conditions may trigger proliferation. Some shorelines could be improved by encouraging growth of specific emergent and floating aquatics. Arrowheads, milkweed, water lilies, and pickerelweed flower throughout most of the summer, adding color to a lakeshore. Such improvements would be especially important on lakes in or near metropolitan areas. (Jones-Wisconsin)

W70-08104

THE NEWEST DEVELOPMENT IN LAKE LUZERNE (IN GERMAN),

Eidgenoessische Technische Hochschule, Zurich (Switzerland).

H. Ambuhl.

English summary.

Descriptors: *Lakes, *Oxygen, Phosphorus, Nitrogen, Stratification, Winds, Eutrophication, Fertilization, Oligotrophy, Primary productivity.

Identifiers: Oxygen consumption, Lake Lucerne, Kreutztricher, Obermatt, Gersauer See, Urnersee.

Limnological investigations, conducted during the last 9 years, disclosed the highest oxygen consumption in the oligotrophic part of the lake, exposed to the most intensive mixing by strong and persistent winds. During the past 5 years, the annual average of total phosphorus was doubled, and the nitrate content increased in the last 7 years from 0.34 to 45 milligram/liter nitrogen. Fertilizing experiments, employing plastic bags, have indicated that phosphorus is the most important growth-limiting factor, responsible for the increase of eutrophication and primary production. (Wilde-Wisconsin)

W70-08106

2I. Water in Plants

SOIL-PLANT RELATIONSHIPS OF TWO STEPPE DESERT SHRUBS,

Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

W. H. Rickard, and R. F. Keough.

Plant and Soil, Vol 29, No 2, p 205-212, Oct 1968. 1 fig, 5 tab, 8 ref.

Descriptors: *Deserts, *Desert plants, *Shrubs, *Plant physiology, *Cation exchange, Zerophytes, Arid lands, Soil-water-plant relationships, Washington, Soil profiles, Soil chemical properties, Potassium, Sodium, Leaves, On-site investigations. Identifiers: *Leaf litter.

An eastern Washington plant community in which the dominant shrubs are hopsage (*Grayia spinosa*) and greasewood (*Sarcobatus vermiculatus*) was studied to determine the effects of the plants on soil properties. Leaves and surface soil were analyzed for cationic and moisture contents. The leaf ash content, Na content and moisture were greater in greasewood leaves while K content was greater in hopsage leaves. With age the predominant cation of each species increased. The soil beneath the canopy of a plant showed a greater content of the predominant cation of that species than adjacent soil areas. Cheatgrass (*Bromus tectorum*) beneath greasewood had greater Na contents than cheatgrass growing in other areas, indicating it was taking up Na formerly incorporated in greasewood leaves. The chemical properties of the soil profile show increasing pH, exchangeable Na percentage and conductivity below 4 dm depths, and greater exchangeable K above 4 dm depths. It was concluded that the soil areas around these shrubs are being supplied with increments of K and Na faster than the low rainfall regime can leach them out. The significance of this in terms of the future of the plant community is unknown. (Casey-Arizona)

W70-07757

Field 02—WATER CYCLE

Group 21—Water in Plants

THE BIOLOGY OF THE LARKS (ALAUDIDAE) OF THE KALAHARI SANDVELD,
Cornell Univ., Ithaca, N.Y. Dept. of Ecology and
Systematics.
G. L. Maclean.
Zoologica Africana, Vol 5, No 1, p 7-39, Mar 1970.
19 fig, 6 tab, 64 ref.

Descriptors: *Xerophilic animals, *Deserts, *Birds, *Nests, *Reproduction, Non-migratory birds, Non-game birds, Bird eggs, Clutch, Bird types, Vegetation, Precipitation, Arid lands, On-site investigation, Dunes, River beds, Breeding, Ecosystems, Calcium carbonate.

Identifiers: *Kalahari sandveld, *Nomadic birds, *Larks, *Calcrete, Feeding habits, South Africa.

Of all passerine birds the larks have shown the greatest degree of adaptive radiation in the arid regions of the Old World. This paper examines their ecology in the Kalahari sandveld, where mean annual rainfall predominately summer, is 226 mm and the yearly temperature range is -11 degrees C to 40 degrees C. Nomadic birds occur in various arid regions including the Kalahari and move over wide areas following weather conditions and other favorable environmental variables. Eight breeding species and one non-breeding species, both non-nomadic and nomadic, were described. Red larks live in dunes and grey larks on the calcrete. There is ecological separation in both areas by small differences in vegetation cover. All non-nomadic species were insectivorous which is a great water conservation advantage in arid lands. The nomadic species were all granivorous. Gradations in bill shapes indicated overlapping in feeding habits between insectivorous and granivorous birds. Breeding in all species was initiated by rainfall of at least 20 mm per month. Populations of nomadic species usually increased in breeding periods. The orientation of most nests was towards the east, southeast, or south, at the bases of bushes, insuring maximal protection from the sun. Breeding success averaged 17.9 percent for the family. (Casey-Arizona)

W70-07759

CHANGES IN SOIL NUTRIENT STATUS RESULTING FROM OVERGRAZING AND THEIR CONSEQUENCES IN PLANT COMMUNITIES OF SEMI-ARID AREAS,

University of New England, Armidale (Australia).
Dept. of Botany.

For primary bibliographic entry see Field 02G.
W70-07761

BIOMASS OF DESERT WINTER ANNUAL PLANT POPULATIONS IN SOUTHERN NEVADA,

California Univ., Los Angeles. Lab. of Nuclear Medicine and Radiation Biology.

Janice C. Beatley.

Oikos, Vol 20, No 2, p 261-273, 1969. 3 fig, 2 tab, 12 ref.

Descriptors: *Deserts, *Desert plants, *Plant growth, *Productivity, *Biomass, Xerophytes, Arid lands, Arid climates, Growth stages, Mature growth stage, Vegetation establishment, Soil-water-plant relationships, Life cycles, Precipitation (Atmospheric), Nevada, Shrubs.

Identifiers: *Primary productivity, *Annuals, *Mojave desert, *Great Basin desert, Transition zone, Disturbed site.

In an effort to assess desert ecosystem primary productivity, the biomass of reproductively mature annuals was measured in a region including the Mojave Desert, the Great Basin Desert, and a transitional region. Sixty-eight separate sites, representing the principal kinds of ecosystems in 8 drainage basins, were studied during three successive spring growing seasons. Precipitation, edaphic variables, dominant shrubs and site disturbances were also studied in an effort to relate them to productivity. During the study period, extremes of germination success, growing season length, and density and size of individual plants were seen.

Population distributions were so variable that in nearly two-thirds of the 203 sets of samples the mean dry weight of 20 samples/set was less than the standard deviation. Distribution at germination is a site characteristic and subsequent seedling distribution depends upon survival patterns, not absolute numbers. Year to year variations were great and not correlated with dominant shrub species or growing season lengths but were directly or indirectly related to rainfall. Burned sites were collectively 1.6-11 times as productive as undisturbed sites during the study period. Biomass over the three seasons was greatest in Mojave Desert communities, least in Great Basin communities. (Casey-Arizona)

W70-07763

CARBON DIOXIDE EXCHANGE OF SEEDLING PINES IN THE LABORATORY AS RELATED TO LOWER ELEVATION LIMITS,

Redlands Univ., Calif. Dept. of Biology.

R. D. Wright.

American Midland Naturalist, Vol 83, No 1, p 291-300, 1970. 3 fig, 3 tab, 15 ref.

Descriptors: *Elevation, *Photosynthesis, *Carbon dioxide, *Pine trees, *Drought tolerance, Plant physiology, Plant growth, Root development, Moisture stress, Photoactivation, Leaves, Soil-water-plant relationships, Arid lands, Thermal stress, Light intensity, Chaparral, Trees, California, Greenhouses.

Identifiers: *Elevational adaptations.

Three species of pine, *P. attenuata* (knobcone pine), *P. coulteri* (coulter pine) and *P. lambertiana* (sugar pine) were studied in an effort to determine adaptations relevant to the minimum elevations in their ranges. The former are trees of open chaparral while sugar pine occurs at higher elevations. Gross and net photosynthesis, under differing experimental conditions, were indirectly determined by measuring carbon dioxide exchange. Knobcone and coulter pines demonstrated lower photosynthetic efficiency in reduced light. Sugar pine produces both primary and secondary leaves in its first growth year while the others produce only primary leaves, whose photosynthetic efficiency was much greater, over a wide temperature range, than that of secondary leaves. This might account for greater early root growth in knobcone and coulter pines who also showed more photosynthesis during low temperature acclimation. This was interpreted as a gradient of decreasing drought avoidance since they are better able to utilize light during colder periods when moisture levels are higher at low elevations. Sugar pine was also less resistant to soil water stress. The ramifications of continued chaparral fire control on the future range extensions of knobcone and coulter pines are discussed. (Casey-Arizona)

W70-07764

MEASURED AND ESTIMATED WATER USE BY A CITRUS AND AN APPLE ORCHARD,

Food and Agriculture Organization of the United Nations, Tal-Amara (Lebanon); and Lebanon Agricultural Research Inst., Tal-Amara. Dept. of Irrigation Engineering.

For primary bibliographic entry see Field 03F.
W70-07767

WATER STRESS AND APICAL MORPHOGENESIS IN BARLEY,

Adelaide Univ. (Australia). Waite Agricultural Research Inst.

I. Hussain, and D. Aspinall.

Annals of Botany, NS, Vol 34, No 135, p 393-407, March 1970. 6 fig, 7 tab, 19 ref.

Descriptors: *Moisture stress, *Plant physiology, *Barley, *Soil-water-plant relationships, *Plant growth, Soil moisture, Soil water, Moisture deficit, Moisture content, Water requirements, Leaves, Turgidity, Drought tolerance, Drought resistance, Photoperiodism, Light, Light intensity, Crop response.

Identifiers: *Apical meristem, *Morphogenesis, *Soil water potential, *Primordia, Plant response, Spikelets.

Levels of soil water potential (-1 bar and less) which had little effect on barley plant growth inhibited the formation of new primordia on the apical meristem. Even at water potential levels which completely suppressed primordium formation, leaf growth and morphogenesis of lateral spikelets on the developing ear proceeded at reduced rates. Changes in water potential in apical tissues apparently were not the cause of apex stress sensitivity, because primordium formation was inhibited even when apical water potential was unchanged. This sensitivity of the apex to stress did not appear to be affected by floral initiation. When the plant was exposed to an increased photoperiod, water stress suppressed response by the apical meristem. However, when stress was relieved there were some instances of delayed photo-periodic response. Rate of primordium formation rose in response to an increase in light intensity when water stress was at moderate levels. (Carr - Arizona)

W70-07770

GERMINATION REQUIREMENTS OF THE DESERT SHRUB *LARREA DIVARICATA*,

Duke Univ., Durham, N.C. Dept. of Botany.

Michael G. Barbour.

Ecology, Vol 49, No 5, p 915-923, Late Summer 1968. 5 fig, 5 tab, 24 ref.

Descriptors: *Germination, *Seeds, *Plant growth, *Desert plants, *Environmental effects, Environment, Habitats, Deserts, Arid lands, Arid climates, Xerophytes, Plant physiology, Sites, Reproduction, Seed treatment, Growth stages, Root development, Temperature, Sodium chloride, Osmotic pressure, Light, Soil-water-plant relationships, Water requirements, Soil moisture, Mortality.

Identifiers: *Creosotebush, Sonoran Desert, Mojave Desert, Chihuahuan Desert, Survival, Darkness.

Creosotebush seeds for use in laboratory studies of germination requirements were collected from 34 sites in 3 desert regions of the United States. Listed in order of increasing aridity, the 3 deserts were the Chihuahuan, Sonoran, and Mojave. Although no regional differences in germination behavior were found, optimum laboratory conditions for creosotebush germination included: darkness, temperatures of 23 deg. C, leaching of mericarps with running water, wetting and drying cycles, cold temperature exposure prior to sowing, low NaCl and near-zero osmotic pressure in the sand medium. Maximum root growth occurred at 29 degrees C, slightly acidic medium, low NaCl, and near-zero osmotic pressure. Germination was markedly reduced when seeds were exposed to warm temperatures (37-71 degrees C) prior to sowing. Under optimum greenhouse conditions only 20 seedlings survived for every 100 mericarps sown at the beginning of the 6-month period. Mortality is probably much higher under natural conditions. (Carr - Arizona)

W70-07772

THE PERFORMANCE OF THREE TYPES OF LEAF-WETNESS RECORDERS,

Israel Meteorological Service, Bet-Dagan. Agrometeorological Div.

J. Lomas, and Y. Shashoua.

Agricultural Meteorology, Vol 7, No 2, p 159-166, March 1970. 5 tab, 11 ref.

Descriptors: *Moisture, *Dew, *Leaves, *Measurement, *Equipment, Instrumentation, Performance, Semiarid climates, Humidity, Condensation, Air environment, Meteorology, Plants, Plant pathology, Time, Environmental effects, Environment, Research equipment.

Identifiers: *Leaf wetness, *Dew recorders, Israel, Relative humidity, Standard meteorological screen.

Duration of relative humidity (85 percent and above) in a standard meteorological screen was

compared with duration of leaf wetness recorded by freely exposed field instruments and Taylor instruments located within a crop canopy. Resulting data suggest that direct measurement within the crop is the only accurate method of determining duration of leaf wetness. Taylor-type leaf-wetness recorders were found to be suitable for this purpose. One reason for the interest in leaf wetness is that in semiarid climates duration of dew may be an important factor influencing outbreaks of plant diseases. (Casey - Arizona)

W70-07774

WATER RELATIONS OF THREE WARM DESERT SPECIES,

Nevada Univ., Reno. Desert Research Inst.; and Utah State Univ., Logan. Coll. of Natural Resources.

N. Stark, and L. D. Love.

Israel Journal of Botany, Vol 18, No 4, p 175-190, 1969. 8 fig, 1 tab, 18 ref. OWRR Project A-023-NEV.

Descriptors: *Moisture availability, *Distillation, *Condensation, *Soil water movement, *Evapotranspiration, Soil-water-plant relationships, California, Soil texture, Porosity, Soil types, Soil temperature, Dew, Frost, Climatology, Evaporation, Precipitation, Arid lands, On-site investigations, Phenology, Leaves.

Identifiers: *Death valley, *Relative saturation percentage, *Plant moisture content, Leaf parenchyma, Creosote bush, Pigmecedar, Desert-holly, Hygrothermograph.

An area in Death Valley with dry air, persistent winds, low water table and 2-8 centimeters of rain annually, was studied in an effort to determine the sources of water available to plants and the abilities of three species, *Atriplex hymenelytra* (desert-holly), *Larrea divaricata* (Creosote bush) and *Peucephyllum schottii* (Pigmecedar) to utilize them. Precipitation, aerial moisture, soil water, and distillation were considered potentially available water sources, and evaporation transpiration, and deep seepage, sources of water loss. Climatic, soil moisture, plant moisture content and transpiration data were obtained and correlated. During periods of higher rainfall deep soil moisture increased and was subsequently depleted at temperatures of less than 36-40 degrees centigrade by delivery to the surface soil through distillation and condensation on the undersides of larger rocks near the surface of the coarse soil. Above the hygroscopic level absolute soil moisture was not as important as water delivered by distillation, which was determined to compensate for loss through transpiration. Surface evaporation losses were insignificant, except shortly after rains, while transpiration rates varied with seasonal fluctuations in the plant water status. Larrea showed the greatest physiological adjustment capabilities to low water content and frost, Peucephyllum, the least. Whether the plants utilized aerial moisture was not definitely determined. (Casey - Arizona)

W70-07775

PHYSIOLOGICAL ASPECTS OF DROUGHT DORMANCY IN GRASSES,

University of New England, Armidale (Australia). Dept. of Botany.

R. D. B. Whalley, and A. A. Davidson.

Proceedings of the Ecological Society of Australia, Vol 3, p 17-20, 1968. 1 fig, 3 ref.

Descriptors: *Plant physiology, *Desert plants, *Grasses, Vegetation, Arid lands, Soil-water-plant relationships, Xerophytes, On-site data collection, Plant growth.

Identifiers: *Dormancy, *Soil moisture stress, Reserve carbohydrates, Australia.

Dormancy in plants is characterized by growth cessation and specific adaptive physiological and structural changes. Plants of arid and semiarid climates often show the same growth and structural changes during periods of water stress and it is

speculated that this condition is identical to dormancy. Seasonal dormancy of perennial grasses in humid environments show an increase in carbohydrate reserves in stem base and rhizome, and a decrease following renewed growth. Three species of perennial grasses native to a semi-arid area were regularly analyzed during the growing season for carbohydrates and this was correlated with soil moisture changes. It was found that reserve carbohydrate contents fluctuated the same way between soil moisture stress and rainfall as they do between dormancy and renewed growth. It was concluded that the reactions to soil moisture stress constituted true dormancy and was speculated that the physiological mechanisms are probably similar to those of photoperiod and thermoperiod-induced dormancy. (Casey - Arizona)

W70-07776

THE EFFECT OF SALINITY ON PERMEABILITY OF ROOTS TO WATER,

Arizona Univ., Tucson. Dept. of Biological Sciences; and Arizona Univ., Tucson. Environmental Research Lab.

J. W. O'Leary.

Israel Journal of Botany, Vol 18, No 1, p 1-9, 1969. 2 fig, 2 tab, 29 ref.

Descriptors: *Soil-water-plant relationships, *Root systems, *Osmotic pressure, *Water balance, *Salt tolerance, Turgidity, Permeability, Conductivity, Flow resistance, Biological properties, Resistance networks, Irrigation practices, Irrigation effects, Plant physiology.

Identifiers: *Plant water potential, *Relative water content, *Plant cell permeability, Salt water irrigation.

It was formerly thought that the osmotic pressure of cells of leaves and roots increased as the osmotic pressure of the solution around the roots increased. With constant turgor pressure there would be a corresponding adjustment of the plant water potential, maintaining a relatively constant plant water status. This theory was tested by starting kidney bean seedlings in nutrient solutions and transferring some to solutions of differing salinities. Root permeabilities were subsequently measured in pressure chambers. Water flow rate under pressure was much greater through roots of control plants than through those from saline solutions. The plants grown in saline solutions also showed greater leaf resistance to water vapor diffusion. The water status of the plants was determined by measuring relative water content (RWC) of primary and trifoliate leaves. The primary leaves did not differ in RWC but that of trifoliate leaves decreased with increasing salinity. It was concluded that root permeability decreases during growth in saline solutions and that this causes a great enough reduction of water delivery to the leaves resulting in decreased turgor. This is a form of physiological drought, and implies that irrigation with saline water would be most successful in areas of high humidity. Some methods of overcoming this problem in dry, arid areas are suggested. (Casey - Arizona)

W70-07777

DROUGHT RESISTANCE OF MONTEREY PINE NEEDLES,

Hebrew Univ., Jerusalem (Israel). Dept of Plant Physiology.

H. R. Oppenheimer.

Israel Journal of Botany, Vol 17, No 3, p 163-168, 1968. 1 fig, 3 tab, 14 ref.

Descriptors: *Plant physiology, *Pine trees, *Drought resistance, *Cuticle, *Stomata, Drought tolerance, Soil-water-plant relationships, Moisture deficit, Forced drying, Dehydration, Water requirements.

Identifiers: *Drought avoidance, *Stomatal closure, *Initial damage point, Israel.

Mature needle fascicles of *Pinus radiata* Don (Monterey pine) from the flushes of the three most recent years were subjected to slow dessication to

determine drought resistance capabilities. Transpiration curves indicated a significantly inverse relationship between age and water deficit after 4 days. The initial damage point was reached at a water deficit of only 25 percent showing extreme susceptibility to dehydration. Since stomatal closure in excised needles occurred within 4 hours, subsequent water losses were considered cuticular and restriction of water loss in this phase did not prevent cell damage and early death. These results were compared with those obtained earlier from two more drought-resistant species, *P. halepensis* and *P. pinea*. It was concluded that differences in leaf drought resistance are mainly due to weaker leaf cutivation in *P. radiata*, resulting in greater water loss per unit time. Drought tolerance was essentially the same in all three species indicating it is probably a generic property. The general phenomenon of increased transpiration in dying leaves was discussed. (Casey - Arizona)

W70-07780

ESTIMATION OF WATER STRESSES IN THE ROOT ZONE BY THE DOUBLE-ROOT SYSTEM TECHNIQUE,

Tel Aviv Univ. (Israel). Dept. of Botany.

Y. Waisel, and G. Pollak.

Israel Journal of Botany, Vol 18, No 3, p 123-128, 1969. 2 tab, 2 fig, 15 ref.

Descriptors: *Halophytes, *Wilting point, *Soil-water-plant relationships, *Osmotic pressure, Wilting, Transpiration, Moisture deficit, Plant physiology, Root zone, Moisture content, Circulation (Plants), Water balance.

Identifiers: *Water stress, *Split-root technique, *Adventitious roots, Israel, Non-wilting plants.

The water potentials in different plant organs may vary, but under steady state conditions will reach specific, stable, and related levels. Since halophytic plants in native habitats are subject to variable water stress in the active root zone, it would be useful to determine these stresses utilizing above-ground plant organs. Glass tubes were used as sleeves around the stems of potted plants. They were packed with heavy clay type soil, usually wetted, and sealed at both ends. Sunflowers developed adventitious roots in the sleeves; wilting points were determined by both direct and indirect methods, yielding identical results. Additionally, similar results were obtained with the sleeve technique using a halophytic, non-wilting species, *Aeluropus litoralis*. *Aeluropus* grown in nutrient solutions of differing NaCl and magnesium sulfate concentrations showed almost linear relationships between the salt concentrations and the water stress in the sleeved soil. Stressed plants grown under low and normal transpiration conditions showed similar sleeve water contents. It was concluded that water stresses of the soil around adventitious root systems reflect those around the main root system and that this is due to osmotic adaptation in the auxiliary roots and is independent of temporary water stresses. (Casey - Arizona)

W70-07782

USE OF SOIL, WATER AND LEAF ANALYSES IN GROWING ORANGES IN JORDAN,

Ministry of Agriculture Amman, (Jordan). Research Dept.

For primary bibliographic entry see Field 03F.

W70-07784

GENETIC VARIABILITY IN ROOT DEVELOPMENT IN RELATION TO DROUGHT TOLERANCE IN SPRING WHEATS,

Sydney Univ., Narrabri (Australia). North West Wheat Research Inst.

For primary bibliographic entry see Field 3F.

W70-07785

CARROT POPULATION DENSITY AND YIELD IN AN ARID ENVIRONMENT,

California Univ., Davis. Dept. of Water Science and Engineering.

Field 02—WATER CYCLE

Group 21—Water in Plants

For primary bibliographic entry see Field 03F.
W70-07787

WATER RELATIONS OF BEANS; II. EFFECTS OF DIFFERENTIAL IRRIGATION ON YIELD AND SEED SIZE OF BROAD BEANS,
Khartoum Univ. (Sudan). Dept. of Agronomy.
For primary bibliographic entry see Field 03F.
W70-07788

EFFECT OF PLANT DENSITY AND GROWTH DURATION ON GRAIN SORGHUM YIELD UNDER LIMITED WATER SUPPLY,
National and Univ. Inst. of Agriculture, Rehovoth (Israel). Volcani Inst. of Agriculture Research.
For primary bibliographic entry see Field 03F.
W70-07789

SOME EFFECTS OF SOIL MOISTURE STRESS ON THE GROWTH OF WHEAT (TRITICUM AESTIVUM L. EM THELL.),
Arizona Agricultural Experiment Station, Tucson.
For primary bibliographic entry see Field 03F.
W70-07790

ABSORPTION OF NA, CL, AND B BY DESERT SALTBUCK IN RELATION TO COMPOSITION OF NUTRIENT SOLUTION CULTURE,
California Univ., Riverside.
N. Jerry Chatterton, C. M. McKell, F. T. Bingham, and W. J. Clawson.
Agronomy Journal, Vol 62, No 3, p 351-352, May-June 1970. 2 fig, 1 tab, 6 ref.

Descriptors: *Absorption, *Salt tolerance, *Plant tissues, *Leaves, *Desert plants, Deserts, Arid lands, Environment, California, Sodium, Chlorine, Boron, Salts, Salinity, Chlorides, Inorganic compounds, Cultures, Ions, Halophytes, Plant morphology, Structure.
Identifiers: *Saltbush, *Trichomes, Mesophyll cells, Osmotic potential, Selective absorption.

Salt of tolerance of desert saltbush (*Atriplex polycarpa* (Torr.) S. Wats.) was thought to be related to its leaf anatomy. Therefore, experiments were conducted to study saltbush absorption of Na, Cl, and B in relation to concentration of these elements in water cultures. Plants were grown in NaCl solution cultures with osmotic potentials of -0.8, -10.0, -20.0, and -30.0 atm. Ten and 13% of Na and Cl, respectively, were found in the plants grown at -30.0 atm. Although large amounts of Na and Cl were accumulated in saltbush tissues, salt tolerance may be due to localization of salt in trichomes from adjacent mesophyll cells. This would reduce salt stress within photosynthetically active tissues. In the case of B, a selectivity mechanism operative in the roots reduces its absorption by saltbush and results in less B uptake than is common with many other plants. (Carr-Arizona)
W70-07791

EFFECTS OF SEEDING RATE AND ROW SPACING ON ESTABLISHMENT AND YIELD OF CRESTED WHEATGRASS,
Agricultural Research Service, Fort Collins, Colo. Crops Research Div.; and Colorado Agricultural Experiment Station, Fort Collins.
For primary bibliographic entry see Field 03F.
W70-07792

THE ROLE OF ROOT CYTOKININS DURING WATER AND SALINITY STRESS,
Negev Inst. for Arid Zone Research, Beersheba (Israel). Dept. of Plant Physiology.
C. Itai, A. Richmond, and Y. Vaadia.
U.S. Department of Agriculture Grant FG-18-232. Israel Journal of Botany, Vol 17, No 4, p 187-195, 1968. 2 fig, 3 tab, 24 ref.

Descriptors: *Plant growth regulators, *Moisture stress, *Osmosis, *Root zone, *Salt tolerance, Salinity, Osmotic pressure, Irrigation effects, Soil-

water-plant relationships, Plant physiology, Leaves, Stemflow, Inhibitors, Environmental effects, Drought resistance, Water balance, Circulation (Plants).

Identifiers: *Cytokinins, *Protein synthesis, Mannitol, Carbowax 6000, Kinetin equivalents, Israel.

The growth reduction effects on plants, of salinity and drought have never been adequately explained although many theories have been proposed. Previous work indicated that cytokinins are produced in the roots, possibly regulate shoot growth, and are inhibited by water stress. Five week-old seedlings were subjected to stress by adding NaCl, Carbowax 6000, or mannitol to their nutrient solutions in 2 equal portions over 48 hours. The full stress was terminated after 24 hours. Root exudates were then assayed for cytokinin activity, and the active extract showed proportional decreases in callus growth with increasing dilution. The cytokinin activity in the extract also decreased linearly with increasing NaCl in the nutrient solution. Similar variations with Carbowax 6000 or mannitol indicated this was not an osmotic or specific ionic effect. Increase of NaCl also decreased L-leucine carbon 14 incorporation into leaf discs indicating salt-induced decrease in leaf protein synthesis resulted from cytokinin deficiency. Cytokinin levels rose after termination of stress. The thesis that cytokinin signals root stresses to the shoot causing decreased plant growth even at very low stress levels was considered probable. (Casey-Arizona)
W70-07798

THE ASSESSMENT OF SOIL WATER STATUS AS IT AFFECTS PLANT WATER USE,
National Vegetable Research Station, Wellesbourne (England).
E. J. Winter.

Measurement of Environmental Factors in Terrestrial Ecology, Blackwell Scientific Publications, p 147-159, 1968. 33 ref.

Descriptors: *Soil-water-plant relationships, *Lysimeters, *Soil moisture, *Field capacity, *Moisture availability, Wilting point, Excess water (Soils), Microenvironment, Soil water movement, Water utilization, Tensiometers, Earth-water interfaces, Evaporation, Root systems.
Identifiers: *Exploitable water, *Matric suction, *Moisture release curve, Neutron probe, Resistance blocks.

Total soil moisture content and factors which influence water uptake by roots determine the soil water effects on plant communities. The total soil water is easily determined but measuring the amount available to plants is difficult. The available water is defined as the field capacity minus the permanent wilting percentage. As soil water decreases through evaporation and transpiration, matric suction increases and may be measured by a tensiometer. Exploitable water is available water that can be taken up by plants under specific conditions. The efficiency of its removal depends upon root characteristics and rate of soil water movement toward the roots. The moisture release curve of a given soil must be known so that the amount of soil available water after a given application may be determined. The available water capacity of a soil is a function of the soil texture. Soil water removal by plants may be measured directly by lysimeters or by indirect methods. Various in-situ instruments may be used to measure the evaporative potential of soil sites. An appendix outlines the various methods and instruments for assessing the effect of soil water status on plants. (Casey-Arizona)
W70-07799

HYDROLOGICAL IMPLICATIONS OF GRASS ROOTS STUDIES AT A SITE IN EAST AFRICA,
East African Agriculture and Forestry Research Organization, Nairobi (Kenya). Physics Div.
M. Dagg.

Journal of Hydrology, Vol 9, No 4, p 438-444, December 1969. 7 p, 1 fig, 1 tab, 6 ref.

Descriptors: *Soil moisture, *Grasses, *Transpiration, *Moisture deficit, Moisture stress, Water loss, Wilting point, Specific retention, Moisture content, Soil water movement, Soil-water-plant relationships, Climatology, Consumptive use, Dehydration. Identifiers: *Kenya, Soil moisture resistance.

Soil moisture resistance unit studies show that several perennial grasses root rapidly to depths of 6.1 m under the environmental conditions at Muguga, Kenya, alt. 2070 m, and maintain near potential rates of transpiration until the whole soil profile is near wilting point. With an average annual potential transpiration from grass of 1275 mm, appreciably in excess of the average annual rainfall of 1013 mm, it is concluded that large soil moisture deficits are likely at the start of each rainy season and that through drainage to the groundwater table requires an uncommonly high concentration of about 660 mm of rain within two months. Meteorological and soil conditions over large parts of East Africa would suggest that equally informative results could be obtained elsewhere from simple resistance units, and it has been recommended that routine observation of a few profiles of resistance units over the root range of typical perennial vegetation be added to the normal schedule at agrometeorological stations in East Africa. (Knapp-USGS)
W70-07903

AQUATIC PLANT SURVEY OF MAJOR LAKES IN THE MILWAUKEE RIVER WATERSHED,
Wisconsin Dept. of Natural Resources, Madison.
For primary bibliographic entry see Field 02H.
W70-08104

2J. Erosion and Sedimentation

DEVELOPMENT OF THE ASTORIA CANYON-FAN PHYSIOGRAPHY AND COMPARISON WITH SIMILAR SYSTEMS,
Geological Survey, Menlo Park, Calif. Office of Marine Geology and Hydrology; and Oregon State Univ., Corvallis. Dept. of Oceanography.
For primary bibliographic entry see Field 02L.
W70-07652

SUBMARINE VALLEY SYSTEMS AROUND THE CORAL SEA BASIN (AUSTRALIA),
Scripps Institution of Oceanography, La Jolla, Calif.
For primary bibliographic entry see Field 02L.
W70-07653

TRANSPORT AND DEPOSITION OF HOLOCENE SEDIMENT ON LA JOLLA DEEP SEA FAN, CALIFORNIA,
Scripps Institution of Oceanography, La Jolla, Calif.
For primary bibliographic entry see Field 02L.
W70-07654

DISTRIBUTION OF TRACTIVE FORCE IN OPEN CHANNELS,
Toronto Univ. (Ontario). Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 08B.
W70-07658

THE ENVIRONMENTAL SIGNIFICANCE OF IRON-STAINED QUARTZ GRAINS ON THE SOUTHEASTERN UNITED STATES ATLANTIC SHELF,
Duke Univ., Durham, N.C. Dept. of Geology; and Duke Univ., Beaufort, N.C. Marine Lab.
For primary bibliographic entry see Field 02L.
W70-07665

COASTAL CURRENTS AND MASS TRANSPORT OF SURFACE SEDIMENTS OVER THE

Erosion and Sedimentation—Group 2J

ELF REGIONS OF MONTEREY BAY, CALIFORNIA,
Geological Survey, Menlo Park, Calif. Office of Marine Geology and Hydrology.
For primary bibliographic entry see Field 02L.
W70-07666

ESTING SEDIMENT MOVEMENT DUE TO WAVE ACTION,
Western Australia Univ., Nedlands. Dept. of Civil Engineering.
Jeffrey R. Mogridge.
ASCE Proceedings, Journal of the Hydraulics Division, Vol 96, No HY7, Paper 7433, p 1587-1604, July 1970. 18 p, 9 fig, 2 tab, 21 ref, append.

Descriptors: *Sediment transport, *Bottom sediments, *Waves (Water), *Hydraulic models, Wave pile-up, Ocean waves, Critical flow, Sediment load, Bed load, Mass transfer, Supercritical flow, Beaches, Beach erosion, Currents (Water).
Identifiers: Wave tanks.

The development of laboratory equipment to simulate the water particle motion at the sea bed due to wave action is described. Essentially it oscillates a block of water horizontally in a flume. An inverted U-frame constraining the water measures 84 in. long by 48 in. wide by 24 in. high and is large enough to reproduce prototype boundary conditions. A piston drive is supplied by high pressure oil and motion is controlled to follow a sinusoidal input movement. Previous attempts to model wave action for the study of sediment movement are analyzed and the benefits of the present design are outlined. It is proposed that the equipment be used to study the effects of superimposed wave trains and mass transport velocity on sediment movement. (Knapp-USGS)
W70-07668

NONEQUILIBRIUM TRANSPORT OF SUSPENDED SEDIMENT,
Missouri Univ., Columbia. Dept. of Civil Engineering.
Allen T. Hjelmfelt, and Charles W. Lenau.
ASCE Proceedings, Journal of the Hydraulics Division, Vol 96, No HY7, Paper 7430, p 1567-1586, July 1970. 20 p, 6 fig, 11 ref, 9 append. OWRR Project A-017-MO.

Descriptors: *Sediment transport, *Open channel flow, *Alluvial channels, *Scour, *Transition flow, Convection, Diffusion, Suspended load, Stream erosion, Mathematical studies.
Identifiers: Nonequilibrium sediment transport.

The nonequilibrium transport of suspended sediment in an open channel is studied at an abrupt change from a nonerodible to an erodible bed. The convective-diffusion equation is solved for the case of constant velocity distribution and parabolic eddy diffusion coefficient. Diffusion in the direction of flow is neglected. Graphs of the concentration, distribution, the channel-depth average concentration and the scour rate are presented. (Knapp-USGS)
W70-07669

SUSPENDED MATTER IN THE RED SEA BRINES AND ITS DETECTION BY LIGHT SCATTERING,
Lamont Geological Observatory, Palisades, N.Y.; and Woods Hole Oceanographic Inst., Mass.
For primary bibliographic entry see Field 02K.
W70-07687

TEMPERATURE MEASUREMENTS IN THE BOTTOM LAYERS OF THE RED SEA BRINES,
Cambridge Univ. (England). Dept. of Geodesy and Geophysics.
For primary bibliographic entry see Field 02K.
W70-07688

RADIOCARBON CHRONOLOGY OF RED SEA SEDIMENTS,

Woods Hole Oceanographic Institution, Mass.; and Lamont Geological Observatory, Palisades, N.Y.
David L. Thurber, and Guy G. Mathieu.
In: Hot Brines and Recent Heavy Metal Deposits in the Red Sea; published by Springer-Verlag New York Inc, p 348-359, 1969, 12 p, 5 fig, 2 tab, 28 ref. NSF Grants GA-584 and GA-1346.

Descriptors: *Bottom sediments, *Sea water, *Brines, *Paleoclimatology, *Radioactive dating, Water chemistry, Geothermal studies, Hot springs, Mineralogy, Paleoceanography, Stable isotopes, Sounding, Sampling, Carbon radioisotopes, Chemical precipitation, Geology.
Identifiers: Red Sea, Hot brines, Paleontology.

Radiocarbon dates have been obtained on seven cores taken from the central part of the Red Sea in the axial trough. The observed sedimentation rates (over the past 20,000 years) range from about 5cm/1,000 yr to more than 60cm/1,000 yr. Variations are primarily due to the episodic precipitation of minerals associated with the geothermal activity of the hot-brine deeps. The brine-derived materials precipitate at a rate of more than 40cm/1,000 yr, whereas accumulation rates of the detrital silicates and calcareous shells are on the order of 2cm/1,000 yr and 8cm/1,000 yr respectively, for the area studied. The abrupt world climatic changes at 11,000 years ago which mark the close of the Wisconsin glacial period seen in these cores. Before the warming of world-wide climate at about 11,000 years B. P., the Red Sea environmental condition must have been one of high salinity and regression of the sea. The sill located near the Strait of Bab el Mandeb must have been effective in limiting the water exchanges between the Red Sea and the Indian Ocean during the low sea stand of the Wisconsin. Intrusions of hot brine into the Atlantis II Deep may have occurred over the last 10,000 years. (See also W70-07394) (Knapp-USGS)
W70-07694

SHIPBOARD COLLECTION AND PRESERVATION OF SEDIMENT SAMPLES COLLECTED DURING CHAIN 61 FROM THE RED SEA,
Woods Hole Oceanographic Institution, Mass.

David A. Ross, and Egan T. Degens.
In: Hot Brines and Recent Heavy Metal Deposits in the Red Sea; published by Springer-Verlag New York Inc, p 363-367, 1969. 5 p, 2 fig, 2 plate, 2 tab, 2 ref.

Descriptors: *Sampling, *Bottom sediments, *Oceans, Oceanography, Cores, Mineralogy, Data collections.
Identifiers: *Red Sea, Hot brines.

A brief description is given of the different coring techniques used during the CHAIN 61 cruise to the Red Sea. Locations, core length, type of sampler used and water depth are given for the Red Sea stations. (See also W70-07394) (Knapp-USGS)
W70-07695

CHEMICAL COMPOSITION OF SEDIMENTS AND INTERSTITIAL BRINES FROM THE ATLANTIS II, DISCOVERY AND CHAIN DEEPS,
Kennecott Copper Corp., Salt Lake City, Utah. Exploration Services; and Scripps Institution of Oceanography, La Jolla, Calif.
For primary bibliographic entry see Field 02K.
W70-07698

MICROSCOPIC AND ELECTRON BEAM MICROPROBE STUDY OF SULFIDE MINERALS IN RED SEA MUD SAMPLES,
Kennecott Copper Corp., Salt Lake City, Utah.
J. D. Stephens, and R. W. Wittkopp.
In: Hot Brines and Recent Heavy Metal Deposits in the Red Sea; published by Springer-Verlag New York Inc, p 441-447, 1969. 7 p, 6 fig, 1 tab, 5 ref.

Descriptors: *Bottom sediments, *Mineralogy, *Sulfides, *Mud, Copper, Iron, Electron microscopy, Hot springs, Analytical techniques, Sampling, Sea water, Water chemistry, Chemical analysis, Brines.

Identifiers: Red Sea, Hot brines, Electron beam microprobe.

Base metal distribution in ten Red Sea mud samples recovered by Woods Hole Oceanographic Institution personnel was studied by microscopic and electron beam microprobe techniques. Most of the base metals in the samples were present as sulfides. The most common sulfide mineral was marcasite, but chalcopyrite and marmatite were also identified in many of the samples. Marcasite occurred as euhedral plates or lath-shaped crystals, frequently perched along the center line of euhedral anhydrite crystals. Chalcopyrite and marmatite occurred as irregular or subhedral particles. In several cases, marmatite rims completely surrounded chalcopyrite particles of chalcopyrite rims surrounded marmatite particles. Marcasite was observed filling the interiors of microfossils in several instances. Static electron beam analysis of the marmatite showed that it contained large amounts of iron. Some of the marmatite also contained substantial amounts of copper and traces of cadmium. Copper and zinc values also occurred as a sub-micron dispersion in the mud matrix. (See also W70-07394) (Knapp-USGS)
W70-07699

MINERALOGY AND MICROPALAEONTOLOGY OF A GOETHITE-BEARING RED SEA CORE,
Washington State Univ., Pullman. Dept. of Geology.

Yvonne Hermann, and P. E. Rosenberg.
Work supported by grants from Office of Naval Research and National Science Foundation. Report available for inspection in USGS-WRD Library, Wash, D C. In: Hot Brines and Recent Heavy Metal Deposits in the Red Sea; published by Springer-Verlag New York Inc, p 448-459, 1969. 12 p, 4 fig, 4 tab, 16 ref. ONR Grant Nonr 266 (48).

Descriptors: *Bottom sediments, *Hot springs, *Mineralogy, *Iron compounds, *Spectroscopy, Mud, Analytical techniques, Radioactive dating, Carbon radioisotopes, Sampling, Cores, Sea water, Water chemistry, Chemical analysis, Brines.

Identifiers: Hot brines, Red Sea, Spectrochemical analysis.

The mineralogy and micropaleontology of a goethite-bearing core from the northern Red Sea have been studied. Variations in planktonic microfaunal composition with depth in the core reveal three major climatic phases: Phase I, Post-glacial, encompassing the last 11-12,000 years; Phase II, Late glacial stades which began about 60-65,000 years ago; and Phase III, an interstadial, with a fauna similar to that of Phase I, commencing about 10,000 years ago. The core is composed of sediments containing scattered, lithified, calcareous fragments and lumps, 3 mm to 2 cm in diameter. Goethite is present in sediment samples at all depths and forms an almost monomineralic bed, deposited near the beginning of Phase III. Spectrochemical analyses of the goethite bed indicate a concentration of several heavy metals in excess of the average reported for marine sediments. The goethite is attributed to hot brine activity. Cross-correlations with C-14 dated Red Sea cores and extrapolations assuming constant rates of sedimentation, suggest that the history of hot brine deposition in the northern Red Sea extends back at least 100,000 years B. P. (See also W70-07394) (Knapp-USGS)
W70-07700

MAGNETIC PROPERTIES OF MINERALS FROM THE RED SEA THERMAL BRINES,
Massachusetts Inst. of Tech., Cambridge; and Woods Hole Oceanographic Institution, Mass.
D. W. Strangway, B. E. McMahon, and J. L. Bischoff.

Field 02—WATER CYCLE

Group 2J—Erosion and Sedimentation

In: Hot Brines and Recent Heavy Metal Deposits in the Red Sea; published by Springer-Verlag New York Inc, p 460-473, 1969. 14 p, 12 fig, 2 tab, 29 ref. NSF Project G. P. 5341.

Descriptors: *Bottom sediments, *Mineralogy, *Hot springs, *Magnetic studies, *Iron compounds, Iron oxides, Geochemistry, Geophysics, Sulfides, Analytical techniques, Sampling, Sea water, Water chemistry, Chemical analysis, Brines. Identifiers: Red Sea, Hot brines, Magnetic minerals.

Studies of the magnetic properties of sediment samples recovered from the thermal brine area of the Red Sea were made. The minerals which have distinctive magnetic signatures, particularly on heating, are goethite, lepidocrocite, siderite, manganeseite, pyrite, hematite and small quantities of a ferrimagnetic mineral, which is probably maghemite. Hematite is present in two of the cores recovered from the Atlantis II Deep. The magnetic properties indicate that this material is coarse-grained. By contrast the hematite formed chemically during heating experiments is fine-grained. A ferrimagnetic mineral, probably maghemite, is present in many of the samples examined. Most of this material is destroyed by heating above 500 deg C. The absence of an observable Néel temperature effect in the goethites at 120 deg C is attributed to the small grain sizes, making much of the material superparamagnetic at room temperature. Other data indicate that much of the goethite is in particles less than 100 angstroms. (See also W70-07394) (Knapp-USGS)
W70-07701

SULFUR ISOTOPE STUDIES ON RED SEA GEOTHERMAL BRINES AND SEDIMENTS, California Univ., Los Angeles. Dept. of Geology; and California Univ., Los Angeles. Inst. of Geophysics and Planetary Physics.

I. R. Kaplan, R. E. Sweeney, and Arie Nissenbaum. In: Hot Brines and Recent Heavy Metal Deposits in the Red Sea; published by Springer-Verlag New York Inc, p 474-498, 1969. 25 p, 7 fig, 12 tab, 52 ref. ACS-PRF Number 2815-A2.

Descriptors: *Bottom sediments, *Sea water, *Hot springs, *Stable isotopes, *Sulfur, Analytical techniques, Sampling, Tracers, Water chemistry, Evaporation, Brines. Identifiers: *Red Sea, Hot brines, Sulfur isotopes, Isotope analysis.

Sulfur isotope ratio measurements and trace element analyses were performed on sediment from selected cores from the Red Sea geothermal deposit, the overlying brine and interstitial water. The data show that delta S-34 falls into four general ranges: (1) over 25 per mill, (2) +23 to +15 per mill, (3) +12 to +2 per mill, (4) less than -25 per mill. Sulfate in the brine appears to have been derived from marine evaporites, whereas sulfide originates from two sources. In the Atlantis II Deep, it is derived from a hydrothermal process and introduced with the brine. In the other areas, biological sulfate reduction produces sulfide which precipitates metals from the brine originating in the Atlantis II Deep. (See also W70-07394) (Knapp-USGS)
W70-07702

LEAD ISOTOPES MEASUREMENTS ON SEDIMENTS FROM ATLANTIS II AND DISCOVERY DEEP AREAS, Australian National Univ., Canberra.

J. A. Cooper, and J. R. Richards. In: Hot Brines and Recent Heavy Metal Deposits in the Red Sea; published by Springer-Verlag New York Inc, p 499-511, 1969. 13 p, 5 fig, 2 tab, 37 ref.

Descriptors: *Bottom sediments, *Lead radioisotopes, *Stable isotopes, Mineralogy, *Hot springs, Brines, Analytical techniques, Sampling, Sea water, Water chemistry, Chemical analysis, Trace elements. Identifiers: *Red Sea, Hot brines, Lead isotopes.

In a study of the recent mineralized sediments from the Central Red Sea, a clear difference in the lead isotope pattern is observed in core sections of up to 5m in depth between those from Atlantis II Deep on the one hand and the Discovery Deep and barren sediments on the other. In general, low heavy-metal concentrations correlate with a low overall content of lead with variable isotopic ratios, a pattern observed in other areas of marine sedimentation. The more mineralized samples of Atlantis II Deep, with greater quantities (up to 500ppm) of lead, point to an ore source material with only small isotopic variation. The Discovery Deep samples, although mineralized, exhibit isotopic variation in the lead, suggesting significant contamination, in conformity with ideas that this 'pool' is an overflow from the Atlantis II Deep. Possible sources of the mineralization are considered. It is suggested that the mode of mineralization represented by this deposit is one very possible mechanism for the formation of 'Pyritic Conformable' or 'Straitiform' ore bodies. (See also W70-07394) (Knapp-USGS)
W70-07703

URANIUM SERIES ISOTOPES IN SEDIMENTS FROM THE RED SEA HOT-BRINE AREA, Woods Hole Oceanographic Institution, Mass.

Teh-Lun Ku.

In: Hot Brines and Recent Heavy Metal Deposits in the Red Sea; published by Springer-Verlag New York Inc, p 512-524, 1969. 13 p, 4 fig, 6 tab, 23 ref. NSF Grant GA-584.

Descriptors: *Uranium radioisotopes, *Bottom sediments, *Brines, *Hot springs, *Radioactive dating, Sea water, Radiochemical analysis, Water chemistry, Chemical analysis, Trace elements, Analytical techniques.

Identifiers: *Red Sea, Hot brines, Thorium isotopes.

The distribution of the longer-lived uranium and thorium series isotopes in the iron-rich sediments of the Red Sea geothermal brine area is characteristics. Concentrations of uranium on a salt- and water-free basis range from 6 to 30 ppm, whereas those of thorium range from 0.1 to 0.5 ppm. The low Th/U ratios are also reflected by the low activity ratios of Th-230/U-234 and Pa-231/U-235, considerably less than the secular equilibrium value of unity. Maximum ages of the deposits may be estimated. The metalliferous sediments accumulated at a rate of at least 40 cm/1000 yr and that the sampled four to eight meters of sediment columns in the Atlantis II Deep were deposited in less than 10,000 years. An important fraction of uranium may have been scavenged out of the overlying normal Red Sea water through co-precipitation with the colloidal ferric hydroxide and silica. (See also W70-07394) (Knapp-USGS)
W70-07704

COMPARISON BETWEEN RED SEA DEPOSITS AND OLDER IRONSTONE AND IRON-FORMATION, Geological Survey, Washington, D.C.

Harold L. James.

In: Hot Brines and Recent Heavy Metal Deposits in the Red Sea; published by Springer-Verlag New York Inc, p 525-532, 1969. 8 p, 1 fig, 2 tab, 21 ref.

Descriptors: *Bottom sediments, *Mineralogy, *Geochemistry, *Hot springs, *Brines, Water chemistry, Iron compounds, Trace elements, Sea water, Carbonate rocks, Geology, Sediments, Diagenesis, Leaching.

Identifiers: *Red Sea, Hot brines, Ironstone, Iron formations.

Physically the Red Sea sediment is utterly unlike either ironstone or iron-formation, but chemically it has affinities to both except for its remarkable content of base and precious metals. If the Red Sea sediment were being deposited in an environment of strong current and wave action, the resulting product probably would be an ironstone of reasonably orthodox character. If it were to be bu-

rried in its present form, a remote possibility exists that it could become chemically differentiated through dewatering and diagenetic processes to yield an end product comparable to iron-formation, but more likely a substantial part of the iron and much or all of the base metals would migrate in hot brine solutions to be reprecipitated in laterally continuous carbonate host rocks. (See also W70-07394) (Knapp-USGS)
W70-07705

ECONOMIC POTENTIAL OF THE RED SEA HEAVY METAL DEPOSITS, Woods Hole Oceanographic Institution, Mass.; and Geological Survey, Woods Hole, Mass.

J. L. Bischoff, and F. T. Manheim.

In: Hot Brines and Recent Heavy Metal Deposits in the Red Sea; published by Springer-Verlag New York Inc, p 535-541, 1969. 7 p, 2 fig, 3 tab, 12 ref. NSF Grant GA-584.

Descriptors: *Bottom sediments, *Mining, *Economics, *Mineralogy, Hot springs, Brines, Geochemistry, Water chemistry, Costs, Iron compounds, Trace elements, Sea water, Geology, Sediments.

Identifiers: Mining costs, Red Sea, Hot brines.

Average assays of metals in Atlantis II Deep deposits are: Fe, 29 per cent; Zn, 3.4 per cent; Cu, 1.3 per cent; Pb, 0.1 per cent; Ag, 54 ppm; Au, (probably) 0.5 ppm. The deposits contained from 55 to 96 per cent interstitial brine, averaging about 85 per cent. Total brine-free sediment in the upper 10 m of sediment is estimated to be over 50 million tons. At current smelter prices for Zn, Cu, Pb, Ag and Au these metals would be worth about 2.5 billion dollars. Deposits in the adjacent Discovery Deep contain lower, but still abnormal, metal concentrations. Metal-bearing deposits probably extend to a depth of about 20 m below the sediment surface, but the metal grade of sediments below 10 m is unknown. Size and grade of the deposits appear to make the deposits attractive for exploitation. (See also W70-07394) (Knapp-USGS)
W70-07706

INTERFERENCE RIPPLE MARKS FORMED BY Ephemeral STREAMS,

Utah Univ., Salt Lake City. Dept of Geological and Geophysical Sciences; and Oberlin Coll., Ohio. Dept. of Geology.

M. Dane Picard, and Lee R. High, Jr.

Journal of Sedimentary Petrology, Vol 40, No 2, p 708-711, June 1970. 4 p, 4 fig, 1 tab, 13 ref. NSF Grant (GA-12570).

Descriptors: *Ripple marks, *Sedimentary structures, *Ephemeral streams, *Alluvial channels, Sand waves, Dunes, Regime, Currents (Water), Turbulence, Turbulent flow, Waves (Water).

Identifiers: Interference ripple marks.

Interference ripple marks form during floods along many ephemeral streams. Cuspate (linguoid) ripples form first when flood water in the channel is deep enough to flow over marginal and channel sand bars. As the water level falls, downstream currents are refracted shoreward over the marginal sand bars and linear ripple sets are formed on the tops and flanks of the bars. The linear ripples are oriented at right angles to the cuspate ripples and commonly form interference sets with them. Refracted waves and changing water level over the irregular bottom can complicate further the patterns of asymmetric ripple marks and other directional structures. Paleocurrent patterns of fluviatile deposits are probably more complex than has been generally recognized. The distribution of directional structures in modern streams is, in general, unimodal and the dominant inclinations of foreset laminae are downstream. (Knapp-USGS)
W70-07892

ANNUAL SUSPENDED SEDIMENT SUPPLIED TO THE CALIFORNIA CONTINENTAL BOR-

DERLAND BY THE SOUTHERN CALIFORNIA

WATERSHED,
Illinois Univ., Chicago.
Kelvin S. Rodolfo.

Journal of Sedimentary Petrology, Vol 40, No 2, p
666-671, June 1970. 6 p, 3 fig, 12 ref.

Descriptors: *Suspended load, *Sediment load,
*Rivers, *California, Sediment yield, Sediment
transport, Particle size, Mineralogy, Sampling,
Analytical techniques.

Identifiers: Southern California.

Southern California streams were sampled at their mouths during a rainy season to determine the concentrations, grain sizes, mineralogy and quantities of suspended sediment supplied to the ocean by the southern California watershed. Approximately 3.5 million tons of suspended sediment are brought to the ocean annually by southern California streams. About 0.8 million tons are arkosic sands, and the remaining 2.7 million tons of river-supplied sediment are silts, clays, colloids and dissolved material. Approximately 4.2 million tons of sand can be attributed to stream traction load. Southern California supplies 7.7 million tons of terrigenous material to the Continental Borderland every year. This estimate agrees well with rates of supply which have been calculated from seismic profiling surveys. (Knapp-USGS)
W70-07893

THE INFLUENCE OF AREAL TRENDS ON CORRELATIONS BETWEEN SEDIMENTARY PROPERTIES,

Northwestern Univ., Evanston, Ill.; and Esso Production Research Co., Houston, Tex.

W. C. Krumbein, and Thomas A. Jones.

Journal of Sedimentary Petrology, Vol 40, No 2, p
656-665, June 1970. 10 p, 6 fig, 6 tab, 5 ref.

Descriptors: *Statistical methods, *Correlation analysis, *Sedimentology, Sedimentary structures, Statistics, Mineralogy, Particle size, Provenance, Simulation analysis, Statistical models.

Identifiers: Trend surface analysis.

The search for relations among sedimentary properties is a basic procedure in the interpretation and reconstruction of sedimentary environments. These relations are commonly expressed as the correlation coefficient, r , between pairs of variates plotted on scatter diagrams. The observed correlations are closely related to trends or systematic patterns of areal variation in the data. The coefficients of trend surfaces can be used to predict the correlation between two mapped variables, and by expressing the correlation in terms of its covariance and variances, the observed relations can be partitioned into systematic and residual portions. A shift of emphasis for consideration of correlation coefficients (which are not additive) to covariance sums of crossproducts (which are) affords additional opportunities for analyzing the contributions of two or more sources of covariation. In this approach trend surface analysis plays an important role in partitioning the crossproduct sum. A statistical model is presented for this purpose, and some sources of covariation in beach foreshore properties are examined in part by simulation studies of areal patterns of variation and the population densities of mapped variables. (Knapp-USGS)
W70-07894

MINERALOGY AND DISTRIBUTION OF CLAY SIZE SEDIMENT IN GLACIER BAY, ALASKA,

State Univ. Coll., Potsdam. Dept. of Geology; and

Alaska Univ., College. Inst. of Marine Science.

Neal R. O'Brien, and D. C. Burrell.

Journal of Sedimentary Petrology, Vol 40, No 2, p
650-655, June 1970. 6 p, 4 fig, 10 ref. AEC Contract AT-(40-3)-310.

Descriptors: *Clays, *Mineralogy, *Sediments, *Fjords, *Alaska, Glaciers, Glacial drift, Bottom sediments, X-ray analysis, X-ray diffraction, Weathering, Provenance.

Identifiers: Glacier Bay (Alaska).

The mineralogy of clay size bottom sediment was studied in the main channel and adjacent fjords in Glacier Bay, Alaska to determine if a lateral change in clay composition occurs as sediment is carried from a fresh water to marine environment. X-ray analysis indicates a dominance of chlorite and trioctahedral mica which does not change in composition or abundance laterally. The lack of diagenetic formation of new minerals probably is due to the rapid rate of clay sedimentation and also due to the minor amount of chemical degradation at the source in this subarctic environment. (Knapp-USGS)
W70-07895

GRAIN SIZE PARAMETERS FOR SANDY-GRAVELS,

Southampton Univ., (England). Dept. of Oceanography.

K. R. Dyer.

Journal of Sedimentary Petrology, Vol 40, No 2, p
616-620, June 1970. 5 p, 5 fig, 1 tab, 12 ref.

Descriptors: *Classification, *Particle size,
*Gravels, *Sands, Statistical methods, Sediments, Sampling.

Identifiers: Sandy gravels.

A series of parameters are proposed to describe the grain size frequency distribution of sandy-gravels. They are shown to be selective in distinguishing variations in the proportions of the two modes, especially at 25% sand, an important point in the packing of bimodal materials. A number of samples from the Solent, a channel between Hampshire, England, and the Isle of Wight, are considered as examples of the sedimentary significance of the use of the parameters in a tidal environment. (Knapp-USGS)
W70-07896

EROSION BY BIOLOGICAL ACTIVITY IN TWO NEW ENGLAND SUBMARINE CANYONS,

Rhode Island Univ., Kingston. Graduate School of Oceanography.

William P. Dillon, and Herman B. Zimmerman.

Journal of Sedimentary Petrology, Vol 40, No 2, p
542-547, June 1970. 6 p, 9 fig, 9 ref.

Descriptors: *Canyons, *Underwater, *Erosion, Sediment transport, Biochemistry, Weathering, Sediments, Topography.

Identifiers: Biological erosion processes, Submarine canyons.

Observations from Deepstar 4000 in Block and Corsair Canyons indicate that, at present, erosion is predominantly biological. No evidence for large mass movements in the axis area or recent turbidity current activity was observed in either canyon. (Knapp-USGS)
W70-07897

VELOCITIES OF CULVERT JETS FOR INCIPIENT EROSION,

Geological Survey, Mineola, N.Y.; and Cincinnati Univ., Ohio. Dept. of Civil Engineering.

Gerald E. Seaburn, and Louis M. Laushey.

French summary included. Proceedings 12th Congress of the International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ., Fort Collins, Vol 3 (Erosion and local scour downstream from hydraulic structures), Paper C1, p 46-54, 1967. 9 p, 4 fig, 1 tab, 11 ref.

Descriptors: *Scour, *Culverts, *Jets, *Engineering structures, *Erosion, Streambeds, Stilling basins, Stones, Pipe flow, Momentum equation, Shear drag, Tailwater.

Identifiers: *Velocities of culvert jets, Streambed erosion.

High capacity culverts too often cause streambed erosion at the outlet. The construction of stilling basins designed to reduce erosion is too expensive and is seldom justified for small culverts. Theoretical and experimental studies were undertaken

using loose stones to prevent erosion at the outlet of small culverts. The critical velocity that will initiate erosion was found by trials under full-pipe and partially-full pipe flows. In the full-pipe flow, the critical momentum was proportional to the cube of the stone size. Further, a larger velocity was required to scour the spheres than the stones, because the spheres have a smaller drag coefficient and a better hydrodynamic shape. The pipe diameter is not a useful parameter in partially-full pipe flow. The critical velocity of the outlet of culverts required to initiate the scouring of a noncohesive bed is (1) dependent on the size of stones and the diameter of the culvert if the culvert flows full; and (2) dependent on the stone size but independent of the diameter of the culvert if this flows only partly full. The tailwater provided no protection against bed erosion when the depth of pipe was less than one-half of the pipe diameter. (Carstea-USGS)
W70-07912

INITIAL SCOUR AND SEDIMENT MOTION DUE TO AN IMPINGING SUBMERGED JET,

Technion - Israel Inst. of Tech., Haifa.

For primary bibliographic entry see Field 08B.

W70-07913

DETERMINATION OF THE DEPTH OF SCOUR AROUND AN OBSTRUCTION IN AN ALLUVIAL CHANNEL,

Central Water and Power Research Station, Poona (India).

For primary bibliographic entry see Field 08B.
W70-07914

MEAN-VELOCITY CRITERION FOR SCOUR OF COARSE UNIFORM BED-MATERIAL,

Research Council of Alberta, Edmonton.

C. R. Neill.

French resume included. Proceedings 12th Congress of the International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ., Fort Collins, Vol 3 (Erosion and local scour downstream from hydraulic structures), Paper C6, p 46-54, 1967. 9 p, 4 fig, 1 tab, 11 ref.

Descriptors: *Scour, *Streambeds, *Sediment transport, *Bed load, Flumes, Particle size, Flow, Shear stress, Channels, Erosion, Alluvial channels.

Identifiers: Stones.

Flume experiments were conducted using 6 to 30 mm grain-size particles for uniform bed materials to study the initial motion of particles. A nomogram was derived which gives the 'competent mean velocity' for coarse materials in terms of grain size, grain density, and depth of flow. The conditions under which single stones in a uniform bed will be first displaced under gradually increasing strength of flow are given. The first displacement of particles are correlated with mean velocity rather than shear stress. The mean-velocity data for uniform coarse material in wide channels compared well with data of other investigators who used materials up to 140 mm. A direct comparison with Shield's data is not possible. (Carstea-USGS)
W70-07915

ON THE MECHANISM OF THE LOCAL SCOUR FROM FLOWS DOWNSTREAM OF AN OUTLET,

Kyoto Univ. (Japan). Disasters Prevention Research Inst.

Yoshito Tsuchiya, and Yuichi Iwagaki.

Proceedings 12th Congress of the International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ., Fort Collins, Vol 3 (Erosion and local scour downstream from hydraulic structures), Paper C7, p 55-64, 1967. 10 p, 8 fig, 6 ref.

Descriptors: *Scour, *Outlets, *Hydraulic structures, *Sediment transport, Downstream, Jets, Tractive forces, Particle size, Mathematical models, Saltation, Specific gravity, Shear, Velocity, Model studies, Alluvial channels, Stream erosion.

Field 02—WATER CYCLE

Group 2J—Erosion and Sedimentation

Identifiers: *Scour development, Scour mechanisms.

Local scour downstream of hydraulic structures is a very complicated phenomenon because the sediment is transported under nonequilibrium conditions. Basic experiments were conducted on the local scour downstream of an outlet using theories of wall jets and of critical tractive force. Both the initial and progressive stages of development of local scour were studied. A simple mathematical model describes nonequilibrium transport. Saltation length, shear velocity, sedimentation rates, critical shear velocity, distance, specific gravity of grains, and grain size need to be known in order to calculate the rate of sediment transport. In the initial stage of development, the theoretical configuration of the scour hole, rate of sediment transport, and change in maximum depth of scour are in good agreement with the experimental values. In the progressive stage of scour development, the maximum rate of sediment transport occurs at the end of the scour hole. The scour process becomes stable when the sediment in the scour hole cannot move along the hole because of the decrease in the shear velocity, and the rate of sediment transport by the wall jet becomes equivalent to the recurrent rate due to the roller. (Carstea-USGS)
W70-07916

SCOUR IN STONE BEDS,

Saskatchewan Univ., Saskatoon. Dept. of Civil Engineering; and Crippen (G. E.) and Associate Ltd., Vancouver (British Columbia).
For primary bibliographic entry see Field 08B.
W70-07917

NOTE ON THE METHODS OF STUDY OF THE LOCAL SCOUR OF BED ROCKS ON A REDUCED MODEL,

P. Wisner, M. Radu, and G. Armencea.

English summary included. Proceedings 12th Congress of the International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 3 (Erosion and local scour downstream from hydraulic structures), Paper C9, p 74-82, 1967. 9 p, 8 fig, 10 ref.

Descriptors: *Scour, *Alluvial channels, *Streambeds, *Model studies, *Energy dissipation, Dams, Spillways, Velocity, Arch dams, Cohesive soils, Cohesionless soils, Sands, Sediment transport, Stream erosion.

Identifiers: *Scour below dams.

Experiments were conducted to study the intensity of local scour below dams as a function of bed material and water velocity. Two kinds of experiments are of particular interest because of their natural occurrences: (1) A spillway with an energy dissipator, and (2) spillway with an arch-dam that throws a free nappe on an unprotected bed. Using an energy dissipator, the scour depth for a bed of cohesive material was much deeper than for non-cohesive material. With no energy dissipator, the form of the scour hole in a bed of concrete blocks was localized and shallower than in a sand bed. (Carstea-USGS)
W70-07918

THE GEOMETRICAL DEVELOPMENT AND DEVELOPMENT IN TIME OF SCOUR BEneath A THIN SLAB,

Hydraulic Research Inst., Prague (Czechoslovakia).

Zdenek Thomas.

French resume included. Proceedings 12th Congress of the International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 3 (Erosion and local scour downstream from hydraulic structures), Paper C10, p 83-91, 1967. 9 p, 4 fig, 3 ref.

Descriptors: *Scour, *Hydraulic structures, *Sediment transport, Hydraulic models, Model studies, Flumes, Tunnels, Sands, Streambeds, Streams, Flow around objects, Bed load, Stress, Stream erosion, Sedimentation.

Identifiers: *Scour geometry, Scour development, Wind tunnel studies.

Flume experiments were carried out using an aerodynamic tunnel to study the geometry and development of scour. The scour of the sandy bottom was accomplished by air currents around a metal sheet. The distance of the lower edge of the slab to the streambed was varied and the scour was measured for various angles of the slab in relation to the horizontal line. The maximum depth of scour was dependent upon its maximum length. The rate of scour formation is not dependent on the distance of the lower edge of the slab from the sand surface but it is dependent upon the angle of inclination of the slab. Empirical equations were derived for the main geometrical characteristics of scour process as a function of inclination angles. Empirical formulas relate the scour depth to the resistance coefficient of bottom and to the tangential stress which corresponds to the beginning of bed load movement. There is good agreement between theoretical conclusions and practical results. (Carstea-USGS)
W70-07919

CONSIDERATIONS CONCERNING SCOUR IN THE CASE OF FLOW UNDER GATES,

Technische Hochschule, Munich (West Germany).
For primary bibliographic entry see Field 08B.
W70-07920

ON SCOUR AROUND SPUR-DIKE,

Nihon Univ., Tokyo.

Seizo Awazu.

French resume included. Proceedings 12th Congress of the International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 3 (Erosion and local scour downstream from hydraulic structures), Paper C12, p 97-104, 1967. 8 p, 4 fig, 3 ref.

Descriptors: *Scour, *Dikes, *Sediment transport, Model studies, Hydraulic models, Channels, Streambeds, Shear stress, Sands, Hydraulic structures, Discharge (Water), Streams, Velocity, Flow profiles.

Identifiers: Movable stream bed, Fixed streambed.

To study the scour process, a movable bed was replaced by a fixed bed and the scouring phenomenon was calculated from the shear and normal forces. The first set of experiments was designed to study the beginning of scouring process. The velocity profiles were determined at every cross-section of the channel centerline, and the shear stress was evaluated. Flow patterns around spur-dikes on movable beds are similar to those on fixed bed channels. There is a direct relationship between the maximum shear stress at the channel centerline and the shear stress where the scouring is expected to occur. The seepage force upon sand grains around spur-dikes is negligible for the distance the spur-dike extends into the impermeable layer. A second set of experiments was intended to study the maximum scour depth using two experimental designs: (1) Two spur-dikes were placed symmetrically, one on each side of a movable bed channel, and (2) A spur-dike was placed on one side of the channel. The data were helpful in proposing formulas on the scour around the spurdikes. (Carstea-USGS)
W70-07921

SCOUR BELOW SUBMERGED SOLID BUCKET-TYPE ENERGY DISSIPATORS,

Mysore Engineering Research Station, Krishnarajaguda (India).
For primary bibliographic entry see Field 08B.
W70-07922

SCOURS BEHIND STILLING BASINS WITH ENDSILLS OF BAFFLE-PIERS,

Technische Hochschule, Brunswick (West Germany).
For primary bibliographic entry see Field 08B.
W70-07923

AN INTERESTING HYDRAULIC EFFECT OCCURRING AT LOCAL SCOUR,
Hydraulic Research Inst., Prague (Czechoslovakia).

For primary bibliographic entry see Field 08B.
W70-07924

EROSION EXPERIENCE DOWNSTREAM OF BED STABILIZATION AND WATER LEVEL CONTROL STRUCTURES,

Corps of Engineers, Omaha, Nebr.

For primary bibliographic entry see Field 08B.
W70-07925

EVOLUTION OF SCOUR DOWNSTREAM FROM A MOBILE BARRAGE RESTING ON INCOHERENT MATERIAL, AND SOME CONSIDERATIONS OF THE SCOUR MECHANISM,

State Hydraulic Works, Ankara (Turkey). Dept. of Research.

For primary bibliographic entry see Field 08B.
W70-07926

ANALYTICAL STUDIES ON THE EFFECT OF FRICTION AND COHESION ON FLOTATION GRADIENTS,

Punjab Univ., Chandigarh (India).

For primary bibliographic entry see Field 08B.
W70-07927

MECHANISM AND COMPUTATION OF LOCAL AND GENERAL SCOUR IN NONCOHESIVE, COHESIVE SOILS AND ROCK BEDS,

Ts. E. Mirtskhulava, I. V. Dolidze, and A. V. Magomedova.

French resume included. Proceedings 12th Congress of the International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 3 (Erosion and local scour downstream from hydraulic structures), Paper C20, p 169-176, 1967. 8 p, 1 tab, 9 ref.

Descriptors: *Scour, *Cohesive soils, *Cohesionless soils, *Streambeds, Erosion control, Flow, Turbulent flow, Forecasting, Mathematical studies, Design criteria, Sediments, Sediment transport. Identifiers: *Local scour, *General scour, Scour depth.

Based on the structure design principles and on the spreading stream theory a relation is given for prognosis of the deepest local scour of noncohesive, cohesive and rock beds. Theoretical, laboratory, and field investigations were used to provide a solution for general and local scour problems. The analogy between the destruction of cohesive soils due to 'fatigue' and that due to turbulent flow was also considered. The problems studied were: (1) The intensity of scour in relation to flow and soil properties; (2) prediction of time required for a given soil to scour; and (3) prediction of scour stabilization. The theory of probability was used to predict erosion in heterogeneous, noncohesive soils. There was good agreement between the experimental and field data. (Carstea-USGS)
W70-07928

A STUDY ON SEEPAGE SURFACE EROSION IN NONCOHESIVE SOILS,

Chalmers Univ. of Technology, Goteborg (Sweden). Hydraulics Div.

S. Lennart Rahm, and Bo G. Appelgren.

French summary included. Proceedings 12th Congress of the International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 3 (Erosion and local scour downstream from hydraulic structures), Paper C21, p 177-184, 1967. 8 p, 4 fig, 1 ref.

Descriptors: *Seepage, *Sheet erosion, *Soil erosion, *Cohesionless soils, Particle size, Water level fluctuations, Water levels, Water storage, Groundwater, Slope stability, Watershed management, Model studies, Equations, Hydraulic gradient, Groundwater movement.

Erosion and Sedimentation—Group 2J

Identifiers: *Groundwater erosion.

Repeated level fluctuations in water storages may by means of groundwater erosion cause considerable damage on unprotected slopes in fine frictional soils. The stable slope section is then rather gentle with safe strength against extensive and even local sliding. On that account the stability concept derives from the entrainment of individual grains at the seepage surface. In this connection the potential field close to the lower terminus of the seepage surface is discussed theoretically, and asymptotic solutions satisfying nonlinear boundary condition are presented. As a practical result it follows that a classical linear condition is reasonable, as the range of nonlinearity is small relative to the grain size. The results of tests carried out for various frictional soils and slope inclinations show that the concept of a critical seepage surface extension offers a simply measurable property. This concept was even applicable to slope section development at repeated level fluctuations considered in long-term tests. (Carstea-USGS)
W70-07929

A THEORETICAL AND EXPERIMENTAL STUDY OF DRAG AND LIFT FORCES ACTING ON A SPHERE RESTING ON A HYPOTHETICAL STREAMBED,

Agricultural Research Service, Oxford, Miss. Sedimentation Lab.

Neil L. Coleman.

French summary included. Proceedings 12th Congress of the International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 3 (Erosion and local scour downstream from hydraulic structures), Paper C22, p 185-192, 1967. 8 p, 4 fig, 4 ref.

Descriptors: *Sediment transport, *Bed load, *Shear drag, *Particle shape, Tractive forces, Sediments, Flow, Laminar flow, Bottom sediments, Streambeds, Reynolds number, Settling velocity.

Identifiers: Drag forces, Lift forces.

A critical force equation is derived for the case of a sphere resting on a bed composed of similar spheres. The analysis includes quantitative consideration of the effects of both interparticle geometry and the action of a supposed lift force. Experiments based on the analysis are described. The drag coefficient-Reynolds number function for the sphere at rest on a bed is shown to be essentially the same as for a sphere in free fall over a range of Reynolds numbers from about 50 to 9400. A lift factor appearing in the critical force equation is shown to be dependent on the particle Reynolds number, and evidence is presented which indicates that the algebraic sign of this lift factor may depend on the presence or absence of a laminar sublayer in the flow in the vicinity of the sphere. Extension of the analytic and experimental results to the case of inception of motion of real sediment particles is briefly discussed. (Carstea-USGS)
W70-07930

LOCAL SCOUR AROUND A CIRCULAR CYLINDER,

Kobe Univ. (Japan). Dept. of Civil Engineering.

For primary bibliographic entry see Field 08B.

W70-07931

APPLICATION OF THE WALL JET THEORY TO EROSION AT THE OUTLET OF HYDRAULIC STRUCTURES,

Corps of Engineers, Mariemont, Ohio; and Cincinnati Univ., Ohio. Dept. of Civil Engineering.

For primary bibliographic entry see Field 08B.

W70-07932

ON THE FLOW CHARACTERISTICS OF VORTICES IN THREE-DIMENSIONAL LOCAL SCOUR,

Waterloopkundig Laboratorium, Delft (Netherlands).

J. J. Vinge.

French resume included. Proceedings 12th Congress of the International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 3 (Erosion and local scour downstream from hydraulic structures), Paper C25, p 207-217, 1967. 11 p, 5 fig, 8 ref.

Descriptors: *Flow characteristics, *Vortices, *Scour, *Sediment transport, Streambeds, Cohesionless soils, Hydraulic structures, Model studies, Hydraulic models, Research and development, Prototype tests, Forecasting.

Identifiers: Mobile bed, Fixed bed.

Scour which is caused by vortices in noncohesive bed material is generally more serious than the local scour associated with two-dimensional flow. For practical purposes, the development of the scouring process with time is very important considering the economy and the stability of structures. For a correct prediction of the time history for prototype conditions, experiments were conducted to establish relationships between sediment transport and flow characteristics. Tests were made with an obstacle in steady flow. A model with fixed bottom was used in order to find relationships between the characteristics of flow and the vortices. (Carstea-USGS)
W70-07933

THE EFFECT OF ENTRAINED AIR ON THE SCOURING CAPACITY OF WATER JETS,

Societe Grenobloise d'Etude et d'Applications Hydrauliques (France).

Geoffrey Johnson.

Proceedings 12th Congress of the International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 3 (Erosion and local scour downstream from hydraulic structures), Paper C26, p 218-226, 1967. 9 p, 4 fig, 6 ref.

Descriptors: *Scour, *Jets, *Air entrainment, Spillways, Tailwater, Diffusion, Nozzles, Gravels, Hydraulics, Turbulent flow, Open channel flow.

Identifiers: *Scouring capacity, Aerated jets.

The scouring capacity of a jet can be significantly changed by air entrainment in the jet. This is particularly important for spillways with wide flow dispersion and subsequent penetration into deep tailwater. Experiments were conducted to study the effect of tailwater upon the scour depth. At shallow tailwater, the scour depth showed a rapid initial increase followed by a very slow increase, over a long period. As the tailwater depth increases beyond that corresponding to maximum scour, the decrease in scour depth becomes regular and appears to correspond with jet diffusion. The compact and dispersed water jets produced similar scours. The air water jet is much more rapidly diffused and the scour ceases at approximately half the tailwater depth required for the solid jet. The significance of the scour depth limit was made by comparing mathematical expressions with practical results. (Carstea-USGS)
W70-07934

THE SCOURING ENERGY OF THE MACROTURBULENT FLOW DOWNSTREAM OF A HYDRAULIC JUMP,

Technische Hochschule, Munich (West Germany).

Hydraulics Research Station, Obenach.

For primary bibliographic entry see Field 08B.

W70-07935

SOME HYDRAULIC CHARACTERISTICS OF TRAPEZOIDAL DROP STRUCTURES,

Alabama Univ., Huntsville. Dept. of Fluid Mechanics; and Federal Power Commission, Washington, D.C.

For primary bibliographic entry see Field 08B.

W70-07936

TIME SCALE OF TWO-DIMENSIONAL LOCAL SCOUR,

Waterloopkundig Laboratorium, Delft (Netherlands).

H. N. C. Breuers.

French resume included. Proceedings 12th Congress of the International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 3 (Erosion and local scour downstream from hydraulic structures), Paper C32, p 275-282, 1967. 8 p, 6 fig, 3 ref.

Descriptors: *Scour, *Dimensional analysis, *Sediment transport, Sediments, Time, Model studies, Hydraulic models, Velocity, Streams, Streamflow, Streambeds, Turbulence, Flumes.

Identifiers: *Local scour, Noncohesive sediments, Hydraulic conditions.

The time scale of the scouring process in noncohesive sediments should be estimated from considerations of the sediment transport and the flow pattern in the scouring holes. Model studies showed that the maximum scouring depth varied exponentially with time and the relationship was nearly independent of the flow configuration. The determination of time scale for different conditions was carried out in 3 flumes of different size on a scouring stony streambed. The velocity profile and the turbulence intensity are important factors in the scouring process and this importance was documented experimentally. The use of time scale is justified by the similarity of experimental scouring holes under different conditions. (Carstea-USGS)
W70-07937

INFLUENCE OF TIME AND HYDROGRAPH OF FLOODWATER ON THE EROSION OF ARTIFICIALLY CONTRACTED STREAM BEDS,

For primary bibliographic entry see Field 08B.

W70-07938

EFFECT OF FLOOD HYDROGRAPHS ON THE REGIME OF ALLUVIAL AND BOULDER STAGE RIVERS ABOVE AND BELOW CONTROL STRUCTURES,

Uttar Pradesh Irrigation Research Inst., Roorkee (India).

For primary bibliographic entry see Field 08B.

W70-07939

COMPUTATIONS ON NON-STEADY BEDLOAD-TRANSPORT BY A PSEUDO-VISCOSITY METHOD,

Waterloopkundig Laboratorium, Delft (Netherlands).

C. B. Vreugdenhil, and M. de Vries.

French summary included. Proceedings 12th Congress of the International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 3 (Erosion and local scour downstream from hydraulic structures), Paper C35, p 303-313, 1967. 11 p, 6 fig.

Descriptors: *Bed load, *Sediment transport, *Viscosity, Channel morphology, Alluvial channels, Banks, Numerical analysis, Hydraulic properties, Erosion, Sedimentation, Model studies, Streams.

Identifiers: *Non-steady bed-load transport, Pseudo-viscosity method, Channel geometry.

The behavior of the bottom level of an alluvial channel with fixed banks is studied with regard to changes in hydraulic conditions. The numerical procedure and the concept of pseudo-viscosity used for computations of non-steady bed-load transport are discussed. Examples of computation by the method of characteristics are given for a simple case of erosion or sedimentation and for a mixed case of erosion and sedimentation. These computations are compared with experimental data from a river model in the Netherlands. There is a reasonable agreement between field measurements and computations. (Carstea-USGS)
W70-07940

Field 02—WATER CYCLE

Group 2J—Erosion and Sedimentation

RIVER BED SCOUR AT BRIDGE CONSTRUCTIONS,
Central Water and Power Research Station, Poona (India).
For primary bibliographic entry see Field 08B.
W70-07941

BANK PROTECTION ON U.S. NAVIGABLE WATERWAYS,
Mississippi River Commission, Vicksburg, Channel Improvement Branch.
Raymond H. Haas, and Jimmie Graham.
Perma. Int. Asso. of Navigation Congr., XXIInd Int. Navigation Congr., Sect. 1, Subj 6, Inland Navigation, p 169-197, Paris, 1969. 29 p, 8 photo, 19 ref.

Descriptors: *Retaining walls, Alluvial channels, Grading, Dredging, Laterals, Detention reservoirs, Costs, Bank stability.

Identifiers: Direct protection, Indirect protection.

Bank revetments must be designed within a framework covering the grading and determination of rivers. The paper deals with both the actual revetment of banks (called direct protection) and the structures intended to determine curves, alignments and depths (called indirect protection). The problem of free current rivers in the alluvial zone is analyzed. The layout of the channel should interfere as little as possible with free current rivers; this standard is the lowest cost alternative. The choice of the type of revetment depends on numerous factors which can react with each other (sediment concentration, mechanical characteristics of the soil, upward pressures). Five methods for the stabilization of rivers are given: grading of the bed, dredging, canalization, lateral canals, and accumulation reservoirs. Grading is the most practical and the cheapest method. The article is written in English and includes a French summary. (Grossman-Rutgers)

W70-07942

BANK PROTECTION OF THE MANCHESTER SHIP CANAL,
Manchester Ship Canal Co. (England).
For primary bibliographic entry see Field 08A.
W70-07943

SHIP-CANAL BANK PROTECTION,
Technische Hogeschool, Delft (Netherlands).
For primary bibliographic entry see Field 08A.
W70-07944

ECONOMICS OF BANK PROTECTION ON CANALS AND NAVIGABLE RIVERS (IN FRENCH),
Service Technique de la Direction des Ports Maritimes et des Voies Navigables (France).
For primary bibliographic entry see Field 08A.
W70-07947

THE STUDY OF THE SCOURS BEHIND A SPILLWAY, (IN FRENCH),
For primary bibliographic entry see Field 08B.
W70-08095

2K. Chemical Processes

A FOURTH BRINE HOLE IN THE RED SEA,
Atlantic Oceanographic and Meteorological Labs., Miami, Fla. Sea Air Interaction Lab.
Feodor Ostanoff.

In: Hot Brines and Recent Heavy Metal Deposits in the Red Sea; published by Springer-Verlag New York Inc, p 18-21, 1969. 4 p, 3 fig, 2 tab, 8 ref.

Descriptors: *Exploration, *Oceanography, *Water chemistry, *Brines, Density stratification, Sounding, Water temperature, Surveys.
Identifiers: *Red Sea, Hot brines.

This paper discusses some of the results of the OCEANOGRAPHER (USC and GSS) crossing of the Red Sea. A possible new hot hole was observed 617km north-northwest of the original hot brine area. Three reflecting layers were observed in the Atlantis II Deep that are apparently related to the different brine layers. (See also W70-07394) (Knapp-USGS)
W70-07679

GEOLOGICAL STRUCTURES OF THE RED SEA AREA INFERRED FROM SATELLITE PICTURES,
North American Rockwell Corp., Thousand Oaks, Calif. Science Center.

For primary bibliographic entry see Field 07B.
W70-07680

THE RED SEA -- A GEOPHYSICAL BACKGROUND,
Newcastle-upon-Tyne Univ. (England). School of Physics.
For primary bibliographic entry see Field 07C.
W70-07681

BATHYMETRY AND CONTINUOUS SEISMIC PROFILES OF THE HOT BRINE REGION OF THE RED SEA,
Woods Hole Oceanographic Institution, Mass., and Alpine Geophysical Associates, Inc., Norwood, N.J.

David A. Ross, Earl E. Hays, and Frank C. Allstrom.

In: Hot Brines and Recent Heavy Metal Deposits in the Red Sea; published by Springer-Verlag New York Inc, p 82-97, 1969. 16 p, 7 fig, 21 ref. NSF Grant GA-584.

Descriptors: *Sounding, *Oceanography, *Brines, Density stratification, Geophysics, Saline water, Mineralogy, Stratigraphy, Seismic studies.
Identifiers: *Red Sea, Hot brines.

A detailed bathymetric and geophysical study has been made of the three known deeps in the hot brine region of the central rift valley of the Red Sea. Continuous seismic profiling produced a distinct reflection from the hot brine-normal sea water contact in the Atlantis II and Discovery Deep. The deeps are covered with a thin veneer of heavy-metal rich sediments. A major portion of the Atlantis II Deep contains more than 20m of heavy metal deposits. The sediment distribution in the brine area is compatible with a brine source in the Atlantis II Deep and periodic overflows into Chain and Discovery Deep at some time in the past. A subsurface seismic reflector postulated to be an unconformity of late Miocene or early Pliocene age is common to records from the flanks of the deeps. (See also W70-07394) (Knapp-USGS)
W70-07682

THERMAL MEASUREMENTS IN THE RED SEA HOT BRINE POOLS,
Massachusetts Inst. of Tech., Cambridge. Dept. of Geology and Geophysics.

Albert J. Erickson, and Gene Simmons.

In: Hot Brines and Recent Heavy Metal Deposits in the Red Sea; published by Springer-Verlag New York Inc, p 114-121, 1969. 8 p, 5 fig, 2 tab, 20 ref. ONR Contract Nonr 1841 (74).

Descriptors: *Brines, *Saline water, *Density stratification, *Water temperature, Sampling, Sounding, Oceanography, Hot springs, Geothermal studies, Saline water systems, Bottom sediments, Exploration, Surveys.
Identifiers: *Red Sea, Hot brines.

Fourteen thermal gradient measurements in the sediments beneath the Atlantis II Deep show large temperature variations both with location in the deep and vertically within individual measurements. Maximum sediment temperature observed was 62.3 deg C. Thermal gradients ranging from

3.75 deg C/m (hotter at depth) to -0.87 deg C/m (cooler at depth) were found, with a tendency for gradients in regions of high absolute temperature to be small or slightly negative. The average measured conductive heat flux into the 56 deg C water of 15 to 20 microcal/sq cm sec is inadequate to provide the heat lost to the 44 deg C water above or to warm the 56 deg C water. Of possible heat transfer mechanisms considered, the uniform convection of hot brine through the sediment beneath the Atlantis II Deep appears most likely to be active now, although former periods of hydrothermal discharge are probable. (See also W70-07394) (Knapp-USGS)
W70-07683

GENERAL CIRCULATION OF WATER MASSES IN THE RED SEA,
Woods Hole Oceanographic Institution, Mass.
For primary bibliographic entry see Field 02D.
W70-07684

HYDROGRAPHY OF THE RED SEA BRINES,
Woods Hole Oceanographic Institution, Mass. P. G. Brewer, C. D. Densmore, R. Munns, and R. J. Stanley.

In: Hot Brines and Recent Heavy Metal Deposits in the Red Sea; published by Springer-Verlag New York Inc, p 138-147, 1969. 10 p, 6 fig, 9 tab, 12 ref.

Descriptors: *Brines, *Saline water, *Hydrography, *Oceanography, *Water temperature, Mapping, Sounding, Surveys, Water chemistry, Sampling, Geochemistry, Geothermal studies, Saline water systems, Bottom sediments, Mineralogy, Density stratification.
Identifiers: *Red Sea, Hot brines.

The temperature and salinity characteristics of the Red Sea brines and their overlying waters are discussed, and data from the 1966 CHAIN cruise are presented. Most papers on this subject have reported 'salinity' values derived from volumetric dilution of the sample with distilled water and conductometric measurement of the dilute sample. The errors in this procedure are described, and the true salinity of a number of samples has been measured. Layering in the brines is discussed. Some practical difficulties of sampling in the deeps are outlined. (See also W70-07394). (Knapp-USGS)
W70-07685

TEMPERATURE STRUCTURE OF THE RED SEA BRINES,
Woods Hole Oceanographic Institution, Mass. David A. Ross.

In: Hot Brines and Recent Heavy Metal Deposits in the Red Sea; published by Springer-Verlag New York Inc, p 148-152, 1969. 5 p, 2 fig, 2 tab, 17 ref.

Descriptors: *Brines, *Water temperature, *Sounding, *Sea water, *Density stratification, Thermal stratification, Oceanography, Water chemistry, Geochemistry, Hot springs, Geothermal studies, Saline water systems, Bottom sediments, Surveys.
Identifiers: *Red Sea, Hot Brines.

Temperature measurements obtained by a temperature telemetering pinger show a stratification in the hot brines of the Red Sea. In the Atlantis II Deep a 44 deg C water, which starts at a depth of 2,009m and has a thickness of 28m, overlies the bottom 56 deg C water. The interface between these layers is sharp and only about 5 m thick. In the Discovery Deep a 4 m thick 36 deg C water overlies a bottom 44 deg C water. The interface between these layers is not as sharp as that of the Atlantis II Deep. The Chain Deep has water of at least 34 deg C. Layering may be present; however, the deepest part of this hole was not reached. (See also W70-07394). (Knapp-USGS)
W70-07686

SUSPENDED MATTER IN THE RED SEA BRINES AND ITS DETECTION BY LIGHT SCATTERING,
Lamont Geological Observatory; Palisades, N.Y.;
and Woods Hole Oceanographic Inst., Mass.
William B. F. Ryan, Edwards M. Thorndike,
Maurice Ewing, and David A. Ross.
In: Hot Brines and Recent Heavy Metal Deposits in the Red Sea; published by Springer-Verlag New York Inc., p 153-157, 1969. 5 p, 3 fig, 1 tab, 11 ref. OMR Contract N00014-67-A-0108-0004.

Descriptors: *Water chemistry, *Chemical precipitation, *Mineralogy, *Brines, Oceanography, Sea water, Colloids, Suspended load, Sampling, Instrumentation, Hot springs, Saline water systems, Bottom sediments, Exploration, Density stratification.
Identifiers: *Red Sea, Hot brines.

A dense layer of suspended particulate matter exists below a depth of 1,900m in the Atlantis II Deep in the Red Sea. This layer was detected with a light scattering meter (nephelometer) at two locations within this deep and was found to conform generally to the zone of hot brines. The nepheloid layer scatters light with a constant intensity except for a few very thin internal layers of greater light scattering which correlate with the interface between the different temperature and salinity brines. The intensity of light scattering is found to increase gradually over an interval of eighty meters in the transition zone between the hot brine and the normal Red Sea deep water. The particles which produce the light scattering are interpreted as the colloidal suspensions and mineral precipitates created by the interaction of the reducing, acidic, and metal-containing hot brine with the oxidizing and alkaline overlying normal Red Sea deep water. (See also W70-07394). (Knapp-USGS)
W70-07687

TEMPERATURE MEASUREMENTS IN THE BOTTOM LAYERS OF THE RED SEA BRINES,
Cambridge Univ. (England). Dept. of Geodesy and Geophysics.
David T. Pugh.
In: Hot Brines and Recent Heavy Metal Deposits in the Red Sea; published by Springer-Verlag New York Inc., p 158-163, 1969. 6 p, 3 fig, 14 ref.

Descriptors: *Water temperature, *Density stratification, *Brines, Sea water, Geothermal studies, Oceanography, Saline water, Sounding, Surveys, Hot springs, Bottom sediments.
Identifiers: *Red Sea, Hot brines.

Detailed measurements of temperatures in the water layers immediately above the sediments in Atlantis II and Discovery Deeps are presented. In the bottom 60m of Discovery Deep there is a cooling of 0.5 deg C as the sediment is approached; above 60m the temperature gradient is adiabatic except for a discrete temperature change at 80m. The water column at the bottom is stable. These results suggest periodic outflow of hot saline water from Atlantis II Deep into Discovery Deep. (See also W70-07394). (Knapp-USGS)
W70-07688

A PHYSICAL INTERPRETATION OF THE OBSERVATIONS OF HOT BRINE LAYERS IN THE RED SEA,
Cambridge Univ. (England). Dept. of Applied Mathematics and Theoretical Physics.
J. S. Turner.
In: Hot Brines and Recent Heavy Metal Deposits in the Red Sea; published by Springer-Verlag New York Inc., p 164-173, 1969. 10 p, 1 fig, 3 tab, 21 ref.

Descriptors: *Brines, *Water temperature, *Density stratification, *Hot springs, *Laboratory, Tests, Model studies, Geochemistry, Geothermal studies, Oceanography, Sounding, Exploration, Saline water, Diffusion, Convection, Water chemistry, Sea water, Bottom sediments.
Identifiers: *Red Sea, Hot brines.

The observed temperature structure of the Red Sea brines, which occur as well-mixed layers separated by sharp interfaces, is compared with other natural examples of layering and also with laboratory experiments designed to study the phenomenon. The existence of such layers is characteristic of liquids which are stabilized with salt but are made unstable by heating from below. Various possible mechanisms for their formation and maintenance are evaluated from a physical point of view. The available evidence supports the idea that the source of the brines is in the Atlantis II Deep, which overflowed into the other holes in recent times. (See also W70-07394) (Knapp-USGS)
W70-07691

A NOTE ON THE CHEMICAL COMPOSITION OF THE RED SEA BRINES,

Woods Hole Oceanographic Institution, Mass.
Peter G. Brewer, and Derek W. Spencer.

In: Hot Brines and Recent Heavy Metal Deposits in the Red Sea; published by Springer-Verlag New York Inc., p 174-179, 1969. 6 p, 6 tab, 14 ref. NSF Contract No GA-584.

Descriptors: *Brines, *Water chemistry, *Hot springs, *Sea water, Saline water, Mixing, Density stratification, Manganese, Iron, Salinity, Chemical precipitation, Bottom sediments, Chemical analysis, Water analysis.
Identifiers: *Red Sea, Hot brines.

Samples of brine from the Atlantis II Deep, the Discovery Deep, and the layer of 44 deg C brine overlying the Atlantis II Deep, have been analyzed for the major, and some minor, components. The data are compared with those of other workers and some significant differences are noted. In particular, the Atlantis II brine has been found to have different concentrations of chloride, bromide, sodium and potassium than previously reported. The major ion compositions of the Atlantis II brine and Discovery brine are similar. The chemical composition of the 44 deg C brine in the Atlantis II Deep suggests that it may have formed from the mixing of the highly saline deeper brine and the overlying Red Sea Bottom Water. This brine is rich in manganese but low in iron, owing to precipitation of ferric hydroxide at the 56 deg/44 interface. (See also W70-07394) (Knapp-USGS)
W70-07690

DISSOLVED ARGON, NITROGEN AND TOTAL CARBONATE IN THE RED SEA BRINES,

Scripps Institution of Oceanography, La Jolla, Calif.

R. F. Weiss.

In: Hot Brines and Recent Heavy Metal Deposits in the Red Sea; published by Springer-Verlag New York Inc., p 254-260, 1969. 7 p, 1 fig, 1 tab, 26 ref. NSF Grant GA-666.

Descriptors: *Brines, *Solutes, *Gases, *Sea water, *Geochemistry, Water chemistry, Water analysis, Carbonates, Carbon dioxide, Oxygen, Nitrogen, Stable isotopes.
Identifiers: *Red Sea, Hot brines.

Concentrations of argon, nitrogen, and total carbonate in the Atlantis II and Discovery Red Sea brines were measured by gas chromatography. The isotopic composition of the carbon in the total carbonate of both brines were also measured. Nitrogen and argon are supersaturated by about 250 per cent relative to their solubilities in the brine in equilibrium with the atmosphere. The argon and nitrogen concentrations in the two brines differ by about 10 per cent and 3 per cent, respectively. Large differences were found in total carbonate concentration and in carbon isotopic composition. The possibility that the brines were formed by evaporation, either during some early stage or in coastal lagoons, is discounted by the dissolved gas results. The argon and nitrogen data are consistent with an origin in which the brines were formed from high temperature Red Sea water with the addition of biogenic nitrogen. Water of sufficiently high temperature to be thus considered as a

source of the brines can be found only in shallow coastal areas and in the surface and near-surface waters at the southern end of the Red Sea. (See also W70-07394) (Knapp-USGS)
W70-07691

BACTERIAL SULFATE REDUCTION IN THE RED SEA HOT BRINES,

Woods Hole Oceanographic Institution, Mass.
Hans G. Truper.

In: Hot Brines and Recent Heavy Metal Deposits in the Red Sea; published by Springer-Verlag New York Inc., p 263-271, 1969. 9 p, 1 fig, 3 tab, 45 ref. NSF Grants GB-5199, GB-6314 and GA-584.

Descriptors: *Brines, *Sulfates, *Sulfur bacteria, *Sea water, *Hot springs, Sulfur, Water chemistry, Aquatic environment, Dissolved oxygen, Water temperature, Bottom sediments.
Identifiers: *Red Sea, *Hot brines.

Fresh Red Sea brine samples and mud samples from cores were taken under sterile conditions. Enrichment media for sulfate-reducing and nitrate-reducing bacteria were inoculated with these samples and incubated at room temperature and the respective brine temperature. No positive development was found in cultures inoculated from brines or core muds from the brine area. Only one of five cores from outside the brine area contained sulfate-reducing bacteria, of which two strains were isolate. Water samples from the brine/seawater transition zone in the Atlantis II Deep also resulted in positive enrichments, of which three strains of sulfate-reducing bacteria were isolate. No nitrate-reducing bacteria could be enriched from any of the samples. Only sulfate-reducing bacteria from the Atlantis II Deep brine/seawater transition zone grew well at 10 per cent NaCl/44 deg C and 1/2 concentrated brine 35 deg C. (See also W70-07394) (Knapp-USGS)
W70-07692

THE STERILE HOT BRINES OF THE RED SEA,

Woods Hole Oceanographic Institution, Mass.

Stanley W. Watson, and John B. Waterbury.

In: Hot Brines and Recent Heavy Metal Deposits in the Red Sea; published by Springer-Verlag New York Inc., p 272-281, 1969. 10 p, 1 fig, 6 tab, 12 ref. NSF Grant GA-584.

Descriptors: *Brines, *Sulfates, *Mineralogy, *Sulfur bacteria, *Sea water, Hot springs, Sulfur, Water chemistry, Aquatic environment, Bottom sediments, Water temperature.
Identifiers: *Red Sea, Hot brines.

The brines of the Atlantis II and Discovery Deeps, their sediments and the water overlying these Red Sea brines were examined for the presence or absence of bacteria. No bacteria were found in the Atlantis II sediments and brines, but they were present in the overlying transition and normal 22 deg waters. The sulfate reducing bacteria in this transition layer may account for the sulfur fractionation found in the metal sulfides in the sediments. In the Discovery Deep, bacteria were present in the sediment but were not demonstrated within the brines. The high temperature, salinity and metal concentrations in the Atlantis II brines are thought to act synergistically, preventing the growth of bacteria. The lower heavy metal concentration in Discovery Deep may make conditions slightly less hostile to life and permit the growth of bacteria in the sediments. (See also W70-07394) (Knapp-USGS)
W70-07693

RADIOCARBON CHRONOLOGY OF RED SEA SEDIMENTS,

Woods Hole Oceanographic Institution, Mass.; and

Lamont Geological Observatory, Palisades, N.Y.
For primary bibliographic entry see Field 02J.
W70-07694

Field 02—WATER CYCLE

Group 2K—Chemical Processes

RED SEA GEOTHERMAL BRINE DEPOSITS: THEIR MINERALOGY CHEMISTRY, AND GENESIS, Woods Hole Oceanographic Institution, Mass.

James L. Bischoff.

In: Hot Brines and Recent Heavy Metal Deposits in the Red Sea; published by Springer-Verlag New York Inc., p 368-401, 1969. 34 p, 11 fig, 3 tab, 40 ref. NSF Grant GA-584.

Descriptors: *Brines, *Chemical precipitation, *Bottom sediments, *Sea water, *Water chemistry, Mineralogy, Mixing, Hot springs, Saline water, Geochemistry, Geothermal studies, Sampling, Deposition (Sediments).

Identifiers: *Red Sea, *Hot brines.

Chemical and mineralogical analyses were performed on samples from ten specially selected cores from the Red Sea geothermal deposit. The deposit was divided into seven bedded and laterally correlative facies as follows: (1) detrital; (2) iron-montmorillonite; (3) goethite-amorphous; (4) sulfide; (5) manganese siderite; (6) anhydrite; and (7) manganese. Distribution of the facies, their unconsolidated nature, and age relations indicate that the solids were precipitated out of the overlying brine column, that the area of brine discharge is very local within the Atlantis II Deep, and that the chemistry of the brine has changed considerably with time. Mechanisms of precipitation include simple cooling of subterranean brine as it discharges into the bottom of the Atlantis II Deep and mixing of the brine with the overlying sea water. (See also W70-07394) (Knapp-USGS)

W70-07696

GOETHITE-HEMATITE STABILITY RELATIONS WITH RELEVANCE TO SEA WATER AND THE RED SEA BRINE SYSTEM, Woods Hole Oceanographic Institution, Mass.

James L. Bischoff.

In: Hot Brines and Recent Heavy Metal Deposits in the Red Sea; published by Springer-Verlag New York Inc., p 402-406, 1969. 5 p, 1 fig, 9 ref. NSF Grant GA-584.

Descriptors: *Geochemistry, *Sea water, *Iron compounds, *Oxides, *Brines, Oxidation, Chemical reactions, Chemical precipitation, Equilibrium, Oxidation-reduction potential, Hydrate processes, Water chemistry.

Identifiers: *Red Sea, Hot brines.

Goethite is the dominant ferric mineral in all cores from the Red Sea brine deposits with the exception of core station 84 within the Atlantis II Deep where hematite has been transformed from original goethite and limonite. Review of existent thermochemical data allows construction of an approximate stability diagram relating fields of goethite, hematite, and water to T and water activity at 1 to 200 atmospheres total pressure, conditions relevant to sea water and the Red Sea brines. All conceivable 'normal' submarine environments and the Atlantis II brines plot well within the goethite water stability field. Transformation of goethite to hematite at station 84 appears to result from a local temperature anomaly, suggesting a close proximity to a zone of brine discharge. (See also W70-07394) (Knapp-USGS)

W70-07697

CHEMICAL COMPOSITION OF SEDIMENTS AND INTERSTITIAL BRINES FROM THE ATLANTIS II, DISCOVERY AND CHAIN DEEPS, Kennecott Copper Corp., Salt Lake City, Utah. Exploration Services; and Scripps Institution of Oceanography, La Jolla, Calif.

Ruth L. Hendricks, Frederic B. Reisbick, Edwin J. Mahaffey, D. Blair Roberts, and Melvin N. A. Peterson.

In: Hot Brines and Recent Heavy Metal Deposits in the Red Sea; published by Springer-Verlag New York Inc., p 407-440, 1969. 34 p, 8 tab, 1 ref.

Descriptors: *Bottom sediments, *Brines, *Sea water, *Hot springs, Oceanography, Water chemistry, Chemical precipitation, Mineralogy, Sampling. Identifiers: *Red Sea, Hot brines.

A total of 110 Red Sea brine-deep sediment samples and 58 interstitial water samples have been analyzed by wet chemical and optical spectrographic methods. Most of the interstitial water are essentially saturated with respect to sodium chloride and are enriched in iron, copper, zinc and other heavy metals. The sediment samples show a wide variation in physical appearance and in chemical composition, from oxidized red muds to dark sulfide-rich muds and a few light-colored carbonate-rich samples. Extreme variations in composition are found between adjacent sample sites, and considerable variation is found even within different splits from the same core. Vertical variations in the cores are also extreme, sometimes within a few centimeters of depth. Some of the sulfide-rich parts of this deposit contain high concentrations of zinc, copper and other heavy metals, but the average metal content of the deposits is much lower than would be indicated by these few high values. (See also W70-07394) (Knapp-USGS)

W70-07698

MICROSCOPIC AND ELECTRON BEAM MICROPROBE STUDY OF SULFIDE MINERALS IN RED SEA MUD SAMPLES,

Kennecott Copper Corp., Salt Lake City, Utah.
For primary bibliographic entry see Field 02J.

W70-07699

MINERALOGY AND MICROPALAEONTOLOGY OF A GOETHITE-BEARING RED SEA CORE, Washington State Univ., Pullman. Dept. of Geology.

For primary bibliographic entry see Field 02J.
W70-07700

MAGNETIC PROPERTIES OF MINERALS FROM THE RED SEA THERMAL BRINES,

Massachusetts Inst. of Tech., Cambridge; and Woods Hole Oceanographic Institution, Mass.

For primary bibliographic entry see Field 02J.
W70-07701

SULFUR ISOTOPE STUDIES ON RED SEA GEOTHERMAL BRINES AND SEDIMENTS,

California Univ., Los Angeles. Dept. of Geology; and California Univ., Los Angeles. Inst. of Geophysics and Planetary Physics.

For primary bibliographic entry see Field 02J.
W70-07702

LEAD ISOTOPES MEASUREMENTS ON SEDIMENTS FROM ATLANTIS II AND DISCOVERY DEEP AREAS,

Australian National Univ., Canberra.

For primary bibliographic entry see Field 02J.
W70-07703

URANIUM SERIES ISOTOPES IN SEDIMENTS FROM THE RED SEA HOT-BRINE AREA,

Woods Hole Oceanographic Institution, Mass.
For primary bibliographic entry see Field 02J.

W70-07704

COMPARISON BETWEEN RED SEA DEPOSITS AND OLDER IRONSTONE AND IRON-FORMATION,

Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02J.

W70-07705

ECONOMIC POTENTIAL OF THE RED SEA HEAVY METAL DEPOSITS,

Woods Hole Oceanographic Institution, Mass.; and Geological Survey, Woods Hole, Mass.
For primary bibliographic entry see Field 02J.

W70-07706

DYNAMICS OF AN ARIZONA TRAVERTINE-FORMING STREAM,

Arizona State Univ., Tempe.

For primary bibliographic entry see Field 02F.

W70-07781

EVOLUTION OF INTERSTITIAL WATERS IN RECENT ALASKAN MARINE SEDIMENTS,

Alaska Univ., College. Inst. of Marine Science.

G. D. Sharma.

Journal of Sedimentary Petrology, Vol 40, No 2, p 722-733, June 1970. 12 p, 11 fig, 3 tab, 34 ref.

Descriptors: *Diagenesis, *Glacial drift, *Connate water, *Alaska, *Water chemistry, Solutes, Leaching, Water chemistry, Porosity, Clays, Clay minerals, Mineralogy, Glaciers, Sea water.

Identifiers: Gulf of Alaska.

Recent glacio-marine sediments from southeast Alaska were examined in a study of diagenesis in sediments and pore solutions during transfer from the fluvio-glacial to the marine environment. Large amounts of sediments with minimal chemical weathering are deposited in the fiords, channels and bays in this area. Sodium ion concentration in the interstitial waters varies with depth and between cores. Removal of sodium and enrichment of calcium in sea water occurs during early stages of sediment-sea water interaction. Removal of magnesium accompanied by further removal of sodium from sea water results from thorough mixing of sediments and sea water during transport. The changes in the interstitial waters are primarily due to ion exchange between sediments and trapped pore waters. Sediments containing larger silt fractions remove less sodium from trapped waters than those containing less silt. Particle size distribution, range, mineralogy, and the exposure time of sediments appear to control the nature and the content of ion exchange between sediments and sea water. (Knapp-USGS)

W70-07891

U-234/U-238 DISEQUILIBRIUM AS AN AID TO HYDROLOGIC STUDY OF THE FLORIDAN AQUIFER,

Florida State Univ., Tallahassee. Dept. of Geology.

For primary bibliographic entry see Field 02F.

W70-07907

API RECOMMENDED PRACTICE FOR ANALYSIS OF OIL-FIELD WATERS.

American Petroleum Inst., Dallas, Tex. Div of Production.

API RP 45, American Petroleum Institute Official Publication, 2nd Edition, November 1968. 49 p.

Descriptors: *Chemical analysis, *Water chemistry, *Oil industry, *Analytical techniques, Colorimetry, Flame photometry, Gravimetric analysis, Photometry, Spectroscopy, Sampling, Data collections.

Identifiers: Oil-field waters.

Standard methods of analysis of oil-field waters as developed and recommended by the American Petroleum Institute are presented in a detailed laboratory practice manual. Methods discussed include wet chemical, spectroscopic, photometric, electrochemical, and gravimetric procedures. Analytical quality, sampling methods, data uses, reports, computer data-processing, precision, accuracy, reliability, and significance of results are explained. (Knapp-USGS)

W70-07908

METHODS FOR COLLECTION AND ANALYSIS OF WATER SAMPLES,

Geological Survey, Washington, D.C.

For primary bibliographic entry see Field 07B.

W70-07911

THE ADAPTATION OF PLANKTON ALGAE. V. VARIATION IN THE PHOTOSYNTHETIC CHARACTERISTICS OF SKELETONEMA COSTATUM CELLS GROWN AT LOW LIGHT INTENSITY,
Royal Danish School of Pharmacy, Copenhagen.
Dept. of Botany.

Erik G. Jorgensen.
Physiologia Plantarum, Vol 23, No 1, p 11-17,
1970. 3 fig, 2 tab, 11 ref.

Descriptors: *Photosynthesis, *Diatoms, Pigments, Light, Primary productivity, Sea water, Oceans, Plankton, Laboratory tests, Chlorophyll.
Identifiers: *Skeletonema costatum, Auxospore formation, Cells, Chlorophylla.

The average cells of the diatom *Skeletonema costatum*, maintained at 3 klux continuous illumination and 20°C, decreased their diameter from 8 to 3.5 microns during 6 month vegetative period. A significant correlation was established between cell volume, the rate of photosynthesis, and the content of chlorophyll a. The rate of milligrams carbon per milligram of chlorophyll a/ hour at 1 klux varied between 0.40 and 0.70. The corresponding values for cells deficient in phosphorus or nitrogen were 0.19 and 0.09, respectively. (Wilde-Wisconsin)
W70-08110

THE CHEMICAL ECOLOGY OF THREE SPECIES OF MYRIOPHYLLUM (ANGIOSPERMAE, HALORAGACEAE),

Yale Univ., New Haven, Conn. Dept. of Biology.

G. E. Hutchinson.
Limnology and Oceanography, Vol 15, No 1, p 1-5,
1970. 3 fig, 2 tab, 10 ref.

Descriptors: *Ecology, *Chemical properties, Hydrogen ion concentration, Calcium, Bicarbonates, Photosynthesis, Electrolytes, Hardness (Water), Conductivity, Lakes, Water properties.
Identifiers: *Chemical ecology, *Myriophyllum, Angiospermae, Haloragaceae, Myriophyllum alterniflorum, Myriophyllum spicatum, Myriophyllum verticillatum, Soft water, Sweden, Potamogeton pectinatus, Potamogeton alpinus, Potamogeton natans, Potamogeton gramineus, Potamogeton perfoliatus, Myriophyllum exaltatum.

At least four parameters, varying in a correlative way, may affect the physiological processes of plants independently, namely pH, calcium concentration, bicarbonate concentration, and total electrolyte content. Analysis of data published by Lohammar indicates that *Myriophyllum alterniflorum* occurs in moderately acid, neutral, or slightly alkaline water. Both *Myriophyllum spicatum* and *Myriophyllum verticillatum* extend into waters having higher calcium contents than are apparently tolerated by *M. alterniflorum*. *Myriophyllum verticillatum* has a propensity to occur in waters having a lower pH than those inhabited by *M. spicatum*. The difference is significant and may be correlated with *M. spicatum's* ability, and *M. verticillatum's* inability to use the bicarbonate ion as carbon source in photosynthesis. In a region of northern Sweden, where the lakes did not contain *M. verticillatum*, the soft-water part of its niche may be occupied by *M. spicatum*. Examination of other genera containing two or more species fails to show other clear-cut cases of pH limitation in the alkaline waters studied by Lohammar; usually the more calciphil species seem to require and thrive at high calcium concentrations. It is possible that in very soft water low pH may be limiting. (Jones-Wisconsin)
W70-08112

PHOSPHATE ABSORPTION IN EELGRASS,
Alaska Univ., College. Inst. of Marine Science.
C. Peter McRoy, and Robert J. Barsdate.
Limnology and Oceanography, Vol 15, No 1, p 6-13, 1970. 4 fig, 4 tab, 23 ref.

Descriptors: *Phosphates, *Absorption, Phosphorus radioisotopes, Estuarine environment.

Cycling nutrients, Alaska, Waterfowl, Fish, Invertebrates, Tracers, Aquatic plants, Sediments, Sea water, Leaves, Laboratory tests.

Identifiers: *Eelgrass, *Zostera marina* L, Izembek Lagoon (Alaska), Root hairs, Transport rate, Uptake, Phosphate absorption.

Eelgrass and its associated community is important in the biogeochemical cycle of nutrients in the ocean. Eelgrass is the principal food of hundreds of thousands of migratory waterfowl in Alaska. Additionally fresh or detrital eelgrass feeds numerous species of commercially harvested invertebrates and fishes. The absorption of phosphate by eelgrass (*Zostera marina* L) was studied using phosphorus-32 in partitioned container where leaves were separated from roots and rhizomes. The eelgrass uptake of phosphorus-32 was also studied in the natural, undisturbed environment to supplement the laboratory experiments. Absorption, greatest in light, occurred through both leaves and roots, and the absorbed phosphorus was transported rapidly to all parts of the plant. Apparently eelgrass can use phosphate from sediments and from water. Phosphate removed from solution by the roots and rhizomes was returned in part to the surrounding water through the leaves, suggesting that in nature seagrass may act either as a sink or as a source for dissolved phosphorus in estuarine waters. The phosphate absorption depends on metabolism as well as on a physical process of absorption-exchange. (Jones-Wisconsin)
W70-08114

2L. Estuaries

DEVELOPMENT OF THE ASTORIA CANYON-FAN PHYSIOGRAPHY AND COMPARISON WITH SIMILAR SYSTEMS,

Geological Survey, Menlo Park, Calif. Office of Marine Geology and Hydrology; and Oregon State Univ., Corvallis. Dept. of Oceanography.
C. Hans Nelson, P. R. Carlson, J. V. Byrne, and Tau Rho Alpha.

Marine Geology Vol 8, No 3-4, p 259-291, Apr 1970. 33 p, 10 fig, 3 tab, 64 ref. ONR Contract Nonr 1286 (10).

Descriptors: *Bottom sediments, *Continental slope, *Columbia River, *Turbidity currents, *Marine geology, Washington, Oregon, Deposition (Sediments), Sedimentary structures, Stratigraphy, Pacific Ocean, Pleistocene epoch, Deltas, Currents (Water), Erosion, Sediment transport, Suspended load, Sediments.
Identifiers: *Submarine canyons.

A detailed bathymetric study of Astoria Canyon and Astoria Fan off the Oregon-Washington coast provides a model for typical submarine canyon-fan systems. The present canyon head is 9 miles west of the Columbia River mouth but buried Pleistocene channels appear to have connected the two features in the past. The canyon, which is distinguished by its relief, V-shaped profiles, and numerous tributaries, winds sinuously and is coincident with apparent structural trends across the continental shelf and slope. At the fan apex, the canyon mouth merges smoothly into Astoria Channel, which is characterized by its U-shaped profiles, lower walls of even height, and levee development. Similarity of Astoria Canyon-Fan system with other deep-sea fan and alluvial fan systems, suggests the hypothesis that size of drainage basin, sediment size, and sediment load control the size, gradient, and valley development of any fan system. Cutting of Astoria Canyon and the deposition of the unconsolidated sediment layer forming Astoria Fan could have been cut during the Pleistocene. A similar history can be suggested for other major submarine canyon-fan systems. (Knapp-USGS)
W70-07652

SUBMARINE VALLEY SYSTEMS AROUND THE CORAL SEA BASIN (AUSTRALIA),
Scripps Institution of Oceanography, La Jolla, Calif.

Edward L. Winterer.

Marine Geology, Vol 8, No 3-4, p 229-244, Apr 1970. 16 p, 9 fig, 13 ref. NSF Grant GA681.

Descriptors: *Bottom sediments, *Turbidity currents, *Deposition (Sediments), *Pacific Ocean, *Marine geology, Stratigraphy, Sedimentary structures, Provenance, Deltas, Currents (Water), Erosion, Sediment transport, Suspended load, Bed load, Sands, Mud.
Identifiers: *Australia, *Submarine valleys, Submarine canyons, Coral Sea.

Several major and a host of minor submarine valleys and canyons lead into the deep (4,650 m) Coral Sea basin from the surrounding land, reef, and submarine plateau areas. An integrated submarine drainage system collects sediment from nearly the entire Papuan coast and channels it onto the floor of the basin. The Bligh System drains a 900 km sweep of the Great Barrier Reef coast of Queensland and parts of the Queensland Submarine Plateau. Reflection profiles of the valleys show that they are mainly located in structural depressions, but that the submarine relief has been further accentuated by erosional entrenchment of the valleys into older, probably pelagic, sediments to a depth of as much as 750 m. Since the time of the entrenchment, the valleys and many canyons have been backfilled by as much as 500 m of sediment. The valleys may be thought of as graded, and their filling is assigned to adjustments in the long profiles of the valleys as the Coral Sea basin fills with sediment. (Knapp-USGS)
W70-07653

TRANSPORT AND DEPOSITION OF HOLOCENE SEDIMENT ON LA JOLLA DEEP SEA FAN, CALIFORNIA,

Scripps Institution of Oceanography, La Jolla, Calif.

D. J. W. Piper.
Marine Geology, Vol 8, No 3-4, p 211-227, Apr 1970. 17 p, 7 fig, 2 tab, 25 ref. ONR Contract Nonr 2216 (23).

Descriptors: *Bottom sediments, *Turbidity currents, *Continental slope, *Deposition (Sediments), *California, Sedimentary structures, Stratigraphy, Density currents, Deltas, Currents (Water), Erosion, Sediment transport, Suspended load, Bed load, Sands, Mud, Marine geology.
Identifiers: *Submarine canyons.

Near-surface sediments on La Jolla Fan have been studied using over 100 cores, mostly 60 cm long box cores. Sediment distribution on the fan is apparently related to processes acting along the prominent fan valley, which cuts deeply into Pleistocene sediments. The Holocene sediments in the fan valley consist of sands with some interbedding muds; a few of these muds are in thin beds in which the low sand content is graded. All the other muds are bioturbated. On the open fan away from the fan valley, sands are thinner and rarer. Sedimentary structures within the sands suggest they were deposited from relatively powerful currents, of gradually declining competence, carrying large amounts of sediment in suspension; these are thought to be turbidity currents. Much of the mud also appears to have been deposited from turbidity currents. The Holocene sediments on the fan are about 2 m thick, indicating that about 90% of the sediment being supplied to La Jolla Canyon is bypassing the fan. (Knapp-USGS)
W70-07654

RESEARCH NEEDS ON THERMAL AND SEDIMENTARY POLLUTION IN TIDAL WATERS,
For primary bibliographic entry see Field 05A.
W70-07656

THE ENVIRONMENTAL SIGNIFICANCE OF IRON-STAINED QUARTZ GRAINS ON THE SOUTHEASTERN UNITED STATES ATLANTIC SHELF,
Duke Univ., Durham, N.C. Dept. of Geology, and Duke Univ., Beaufort, N.C. Marine Lab.

Field 02—WATER CYCLE

Group 2L—Estuaries

James B. Judd, William C. Smith, and Orrin H. Pilkey.
Marine Geology, Vol 8, No 5, p 355-362, May 1970. 8 p, 5 fig, 13 ref.

Descriptors: *Sands, *Continental shelf, *Quartz, *Iron oxides, *Provenance, Bottom sediments, Diagenesis, Sediment transport, Littoral drift, Rivers, Deltas, Beaches.

Identifiers: Iron-stained quartz.

An examination of approximately 1,000 continental shelf, beach and river samples from the Atlantic southeastern United States shows that there are significant differences in the percentages of iron-stained quartz grains in two sand-size fractions in each of these major environments. More iron-stained quartz is found in sediments of rivers draining the Piedmont province than those draining the coastal plain. The presence of iron-stained quartz on the shelf may be due in large part to the contributions of rivers during the Pleistocene rather than subaerial weathering of shelf sediments, as indicated by shelf abundance anomalies related to river mouths. These same shelf anomalies are evidence of lack of extensive lateral transportation of sediment on the shelf. Abrasion is apparently not effective in removing the iron coating from the quartz grains in any environment, even in the beach environment. (Knapp-USGS)

W70-07665

COASTAL CURRENTS AND MASS TRANSPORT OF SURFACE SEDIMENTS OVER THE SHELF REGIONS OF MONTEREY BAY, CALIFORNIA,

Geological Survey, Menlo Park, Calif. Office of Marine Geology and Hydrology.

Stephen C. Wolf.

Marine Geology, Vol 8, No 5, p 321-336, May 1970. 16 p, 6 fig, 26 ref.

Descriptors: *Sediment transport, *Bottom sediments, *Currents (Water), *Littoral drift, California, Sediment distribution, Ocean currents, Tides, Shores, Deltas.

Identifiers: Monterey Bay (Calif), Submarine canyons.

In Monterey Bay, California the highest concentrations of medium and fine sands occur nearshore between 10 and 30 fathoms. Silt and clay accumulate in greater depths. Contours of median diameter roughly parallel the isobaths. Fine-grained materials are supplied to the bay region from erosion of cliffs, from sediment laden river discharge, and from continual reworking of widespread sea floor sediments. These sediments in turn are picked up by coastal currents and distributed over the shelf regions by present day current regimes. Studies of bottom currents over the shelf regions and in Monterey Canyon have revealed patterns which vary with seasonal changes. Irregular current flow in the canyon indicates a complex current structure with frequent shifts in direction over very short periods of time. Changes in current regimes are reflected in the patterns of sediment distribution and transport. Sediment transport is chiefly parallel to the isobaths, particularly on the North and South Shelf regions. Some sediments are also transported offshore by rip currents and other agencies and deposited in deeper, quieter waters. Supply of sediments to the canyon head results in over-filling and steepening with subsequent mass movement of sediments seaward followed by deposition in channels and on the broad deep sea fan. (Knapp-USGS)

W70-07666

HYDRODYNAMIC STUDIES OF TIDE GAUGES,

Liverpool Univ. (England). Dept. of Civil Engineering.

For primary bibliographic entry see Field 07A.

W70-07675

UTILIZATION OF PHYSICAL AND MATHEMATICAL MODELS IN MARINE WATER

RESOURCES RESEARCH, PLANNING AND MANAGEMENT,
Virginia Inst. of Marine Science, Gloucester Point. W. J. Hargis, Jr., Yee-chang Wang, Paul V. Hyer, E. P. Ruzecki, and R. Moncure. Available from the Clearinghouse as PB-192 630, \$3.00 in paper copy, \$0.65 in microfiche. Final Report, June 1970. 118 p, 7 tab, 20 fig, 40 ref. OWRR Projects C-1214 and C-1428.

Descriptors: *Estuaries, *Hydraulic models, *Mathematical models, *Instrumentation, *Model studies, Physical models, Mixing, Diffusion, Dispersion, *Circulation, Computer simulation, Virginia, Current meters, *Application methods, Dye releases, Oysters, Flow.

Identifiers: *James River estuary, Salinometer.

During the period 1 September 1967 to 30 September 1969, hydraulic model studies, mathematical and computer studies, and instrument and technique development were studied. An investigation was made into the stability and reproducibility of an estuarine hydraulic model. Studies were made of the dispersion of point-source dye releases in an estuarine hydraulic model, and of the applicability of the results to the release of disease-resistant seed oysters. Analytical studies were made of diffusion in estuaries and of the integro-differential equations for estuarine flow. Computer studies were made of two-dimensional estuarine circulation and of solution of the one-dimensional equations by analogue simulation. Development was carried out on an automated recording salinometer and on a miniaturized current meter for hydraulic models. Computer techniques were developed for use in hydraulic model work.

W70-07801

EVOLUTION OF INTERSTITIAL WATERS IN RECENT ALASKAN MARINE SEDIMENTS,

Alaska Univ., College. Inst. of Marine Science.

For primary bibliographic entry see Field 02K.

W70-07891

MINERALOGY AND DISTRIBUTION OF CLAY SIZE SEDIMENT IN GLACIER BAY, ALASKA,

State Univ. Coll., Potsdam. Dept. of Geology; and

Alaska Univ., College. Inst. of Marine Science.

For primary bibliographic entry see Field 02J.

W70-07895

RELATION OF SEA WATER TO FRESH WATER IN CARBONATE ROCKS IN COASTAL AREAS, WITH SPECIAL REFERENCE TO FLORIDA, U.S.A., AND CEPHALONIA (KEPHALLINIA), GREECE,

Geological Survey, Washington, D.C.

For primary bibliographic entry see Field 02F.

W70-07906

ESTUARINE OXYGEN RESOURCES--PHOTOSYNTHESIS AND REAERATION,

Central Coastal Regional Water Quality Control Board, San Luis Obispo, Calif.

Thomas E. Bailey.

Journal of the Sanitary Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 96, No SA2, p 279-295, 1970. 4 fig, 5 tab, 31 ref.

Descriptors: *Estuaries, *Oxygenation, *Photosynthesis, *Reaeration, Chlorophyll, Phytoplankton, Sanitary engineering, California, Dissolved oxygen, Solar radiation, Light intensity, Depth, Temperature, Seasonal, Diffusion, Hydraulics, Tides, Velocity, Eutrophication, Indicators, Methodology, Equations, California.

Identifiers: Sacramento-San Joaquin Estuary, Suisun Bay (Calif), Light extinction.

Maximum photosynthetic rates occurred throughout Sacramento-San Joaquin Estuary April through September. Photosynthesis was maximum in upstream estuarine areas, decreased longitudinally downstream, and increased in shallow embayments. Photosynthesis and directly related to phytoplankton populations and chlorophyll concentrations. An empirical equation estimating photosynthesis as function of chlorophyll concentration, solar intensity, light extinction coefficient, temperature and water depth can be the basis for mathematical models predicting photosynthesis under changing environmental conditions. Oxygen diffused into water column and atmosphere depending on oxygen saturation degree; observations show that diffusion rates were variable, that complex estuarine physical relationships existed influencing reaeration rates, and that empirical equations derived by other investigators were not directly applicable for calculating reaeration rates; independent direct measurements must be made to determine reliable reaeration and oxygen diffusion rates. The most significant finding of this work shows there is no adequate basis for extending numerical reaeration comparisons from one hydrodynamic system to any other. Data collected throughout estuary show that predictive reaeration coefficient equations do err by as much as two orders of magnitude. Predictive equations or models developed for application in shallow streams or artificial channels are appropriately used only in those identical watercourses. (Jones-Wisconsin)

W70-08103

dinarily downstream, and increased in shallow embayments. Photosynthesis and directly related to phytoplankton populations and chlorophyll concentrations. An empirical equation estimating photosynthesis as function of chlorophyll concentration, solar intensity, light extinction coefficient, temperature and water depth can be the basis for mathematical models predicting photosynthesis under changing environmental conditions. Oxygen diffused into water column and atmosphere depending on oxygen saturation degree; observations show that diffusion rates were variable, that complex estuarine physical relationships existed influencing reaeration rates, and that empirical equations derived by other investigators were not directly applicable for calculating reaeration rates; independent direct measurements must be made to determine reliable reaeration and oxygen diffusion rates. The most significant finding of this work shows there is no adequate basis for extending numerical reaeration comparisons from one hydrodynamic system to any other. Data collected throughout estuary show that predictive reaeration coefficient equations do err by as much as two orders of magnitude. Predictive equations or models developed for application in shallow streams or artificial channels are appropriately used only in those identical watercourses. (Jones-Wisconsin)

PHOSPHATE ABSORPTION IN EELGRASS,

Alaska Univ., College. Inst. of Marine Science.

For primary bibliographic entry see Field 02K.

W70-08114

NUMERICAL ANALYSIS OF DISTRIBUTION OF FLOW AND THERMAL DIFFUSION CAUSED BY OUTFALL OF COOLING WATER,

Central Research Inst. of Electric Power Industry, Tokyo (Japan).

For primary bibliographic entry see Field 05B.

W70-08131

03. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

PRELIMINARY COMMUNITY AND REGIONAL WATER SUPPLY DATA IN SUPPORT OF DESALTING PLANT PROJECTIONS,

Black and Veatch, Kansas City, Mo.

W. L. Patterson, and H. J. Lobb.

Report available for sale by the Superintendent of Documents, US Government Printing Office, Wash, DC 20402 - Price \$2.50. Office of Saline Water Research and Development Progress Report No 519, Apr 1970. 212 p, 9 fig, 2 exhibit, 3 tab, 5 ref.

Descriptors: *Surveys, *Municipal water, *Water supply, *Water resources development, *Desalination, Planning, Data collections, Precipitation (Atmospheric), Project planning, Economic justification, Programs.

Identifiers: Desalination planning.

Basic water supply data needed for future evaluation and selection of promising saline water conversion opportunities are tabulated. Information is presented regarding the present and future supply situation of individual communities. Also presented is information on regional water plans with respect to provisions for municipal water supply. Saline water conversion as a source of municipal supply has potential for application in areas where water supply quality or adequacy is a problem. (Knapp-USGS)

W70-07650

Water Yield Improvement—Group 3B

A STUDY OF A SPECIFIC INFLUENCE OF DISSOLVED IONS ON THE STRUCTURE OF WATER,
Rocketdyne, Canoga Park, Calif.
For primary bibliographic entry see Field 01B.
W70-07651

DESIGN AND CONSTRUCTION OF THE WORLD'S LARGEST FLASH TYPE DESALTING PLANT AT TIJUANA, MEXICO,
Gordon F. Leitner.
Western Water and Power Symposium, Proceedings, p C1-C11, 1968. 3 fig, 4 ref.

Descriptors: *Desalination processes, *Water yield, *Brines, *Contracts, *Contract administration, Engineers estimates, Performance, Flash distillation, Procurement, Specifications, Standards, Economics, Employment, Projects, Budgeting, Costs, Cost-sharing, Evaluation, Water policy, Water supply, Water resources development, Water requirements, Governments, Electric power demand, Water costs.

Identifiers: *Turnkey contract, Brine temperature, Brine recirculation, Long tube design, Performance testing, Startup.

In 1956 about 50,000 gallons of water per day were produced by the then-existent flash type desalting plants. Using current construction plans for desalting plants, the author estimates an increase in unit capacity of 1000 times from 1956 to 1976. Administrative techniques of planning, design, and construction of existing facilities have involved either a joint venture on the part of designer-manufacturer firms and consulting engineering firms, or a lone venture on the part of the designer-manufacturer. Empirically, the former arrangement has been best for the client. A 'turnkey' contract is one in which the designer-manufacturer works in concert with the owner through the intermediary of a consulting engineering firm writing specifications and inspecting the work done. A number of existing desalting plants are described in terms of their capacity, planning, and contractual arrangements. An ongoing project involving an integrated stream electric plant and desalting plant in Tijuana, Mexico is described in depth. Comparative cost investigations, financing arrangements, technological details, labor and construction problems, and contractual arrangements are all examined. It is concluded, from the Tijuana experience, as well as that of other facilities, that the 'turnkey' contract is the best management procedure in this highly complex type of undertaking. (Casey-Arizona)
W70-07765

DESIGN AND OPERATION OF LARGE DESALTING PLANTS,
Robert A. Baker, Jr.
Water and Waste Treatment, Vol 12, No 11, p 356-360, Jan-Feb 1970. 5 p, 6 fig.

Descriptors: *Optimization, *Desalination plants, *Design, *Flash distillation, *Cost Economic efficiency, *Water quality.
Identifiers: Kuwait desalting plant, Point Loma plant, Guantanamo Bay.

The present state and future outlook for large water desalting plants were examined using advances in size and efficiency created over the past twelve years. American industry has made these impressive contributions to water desalting. Yet larger plants that realize the field economy of size available from a proven technology (i.e. flash distillation) to reduce cost of water for underdeveloped areas, are needed. The Kuwait land based desalting plant built in 1957 by Westinghouse was cited as an example of flash distillation. The basically simple design involved four stages. Holding down the first cost was more important in this case than designing for high operating efficiency. Since 1957 when the first Kuwait plant went into operation, three more were put into operation in 1968. They produce water for only a fraction of the cost attained in the first large desalting plant. Another plant built at

Point Loma, near San Diego, California was designed for efficiency. It had thirty-six stages and operated it with either of two scale control systems. Another built at the Guantanomo Bay Naval Base in Cuba was a dual-purpose water-desalting plant and optimized full efficiency as well as held down capital cost. Other plants were described which demonstrated continuing change for efficiency and economy. The optimum large plants of the future may incorporate other technologies of flash distillation, and thus produce not only multiple qualities of water, but also reprocess that water for re-use. (Kriss-Cornell)
W70-07854

OPTIMIZATION OF BASIC PARAMETERS OF THERMAL DESALTING PLANTS WITH ADIABATIC EVAPORATION,

A. I. Korneichev, A. V. Izvekov, and A. A.

Myagkov.

Desalination, Vol 7, No 2, p 179-186, Feb 1970. 8 p, 4 fig.

Descriptors: *Optimization, *Desalination plants, Economic impact, Mathematical models, Equations.

Identifiers: Parameters, Adiabatic evaporation.

A method for complex optimization of the parameters of a multi-stage desalination plant with adiabatic evaporation or with instantaneous boiling up was presented. The computation of optimal parameters of single as well as dual purpose distillation plants by the proposed method was proven not complicated. The problem of choosing the parameters was of primary importance so that the solution could have a high economic effect. Optimization of the parameters was a search for the optimal solution out of a large number of possible alternatives both as to the basic parameters of the working process, and as to special parameters and design solutions for individual plant elements. As a criterion of the optimal quality of the solution arrived at for single-and dual purpose desalting plants, the minimum specific computed expenditure on producing the distillate was taken. The equations for the mathematical model of a desalination plant with adiabatic evaporation were given. The outlined optimization method was said to be applicable to other types of desalination plants. (Kriss-Cornell)
W70-07860

OPTIMUM OPERATION OF DESALTING PLANTS AS A SUPPLEMENTAL SOURCE OF SAFE YIELD,

Utah Water Research Lab., Logan.

Calvin G. Clyde, and Wesley H. Blood.

Final Report to the Office of Saline Water, US Dept of the Int, Utah State Univ, Logan, Utah, July 1969. 127 p, 19 fig, 15 tab, 6 ref, 3 append. PRWG-61-2.

Descriptors: *Digital computers, *Optimization, *Simulation analysis, *Desalination plants, *Design, *Decision making, Reservoirs, Water resources, Hydrologic data, Hydrographs, Water demand.

Identifiers: Cachuma, Deer Creek, New York City.

The specific objectives of the research were: (1) to develop a digital computer program to conveniently determine the optimum operating rule for conjunctive operation of a desalting plant in order to help assess alternatives and to aid in decision making concerning plant design; (2) to apply the Operating Rules Program to three real-life situations where a desalting plant was operated in conjunction with a reservoir and water system; and (3) to assess the impact of conjunctive operation on the performance characteristics and the design of a desalting plant used in intermittent service and to identify the unique features of such plants. The Operating Rules Program received central focus and its general format was easily applicable to a wide variety of conditions. To find the optimum rule the historical hydrologic data for the reservoir

and the water system were first analyzed. Long hypothetical streamflow sequences were then generated. Using the generated hydrographs along with the given reservoir characteristics and an assumed desalting plant capacity, the operation of the desalting plant was simulated by the computer program to test the ability of the various proposed rules to meet the needed water demand. The three real water systems studied were the Cachuma Project near Santa Barbara, California; the Deer Creek Project near Salt Lake City, Utah; and the NYC water supply system. Sensitivity of the optimum operating rule and the associated costs to changes in various input parameters were described. Additional useful research opportunities were suggested. (Kriss-Cornell)
W70-07865

3B. Water Yield Improvement

HYDRAULIC CONDUCTIVITY AND CERTAIN SOIL CHARACTERISTICS OF SUBSOILS WITH SPECIAL REFERENCE TO DRAINAGE DESIGN IN THE ALLUVIAL SOILS OF U.A.R.,
Ain Shams Univ., Cairo (Egypt). Dept. of Soils.
For primary bibliographic entry see Field 02G.
W70-07762

VEGETATION MANAGEMENT FOR WATER YIELD,

Forest Service, (USDA), Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station.

Marvin D. Hoover.

Symposium on Water Balance in North America, Banff, Alberta, Canada, June 23-26, 1967, p 191-195. Proceedings Series 7, Amer. Water Res. Ass'n, Urbana, Ill.

Descriptors: *Water yield improvement, *Vegetation effects, *Watershed management, *Water balance, *Snow management, *Snowmelt, Snowpacks, Timber harvest, Interception, Evapotranspiration, Weather modification, Clearcutting.
Identifiers: Multiple-use management, *Experimental watersheds, Forest patterns, Logging.

Kind, size, and arrangement of plant cover affect distribution of precipitation, snowmelt rates, soil water storage, evaporation and transpiration. These effects are of most significance to streamflow in forested areas where precipitation is comparatively abundant or concentrated into the cool season. These conditions are typical of the source areas for our rivers. Large-scale management of these lands for water may be possible because they are held in large blocks and much is publicly owned. Knowledge is sufficient to select areas of high potential for increased water yield. Yield increases tend to be greater during normally high runoff periods and in wet years. Economic value of such yield increases depends on water uses in the basin and on available storage. Large areas in the West approach ideal vegetation patterns and are now yielding near their potential. Where tree products are merchantable, water increase can be a valuable by-product of timber harvesting. However, where timber is of low wood value or high efficiency in water production desired, financing for water improvement must be found. Artificial augmentation of precipitation appears to offer promise for mountain areas which are often forest covered. Successful weather modification would increase the efficiency of vegetation management practices.
W70-07795

CHANGES IN WATER BALANCE COMPONENTS WITH PASTURE MANAGEMENT IN SOUTH-EASTERN AUSTRALIA,
Soil Conservation Authority, Kew (Australia).

F. X. Dunin.

Journal of Hydrology, Vol 10, No 1, p 90-102, January 1970. 13 p, 1 fig, 5 tab, 14 ref.

Descriptors: *Water balance, *Pasture management, *Rainfall-runoff relationships, Infiltration,

Field 03—WATER SUPPLY AUGMENTATION AND CONSERVATION

Group 3B—Water Yield Improvement

Evapotranspiration, Water yield, Water yield improvement, Carrying capacity.
Identifiers: *Australia.

A method for evaluating infiltration and evapotranspiration for experimental catchments was applied to a series of four-acre catchments near Bacchus Marsh, Victoria, Australia. Differences in runoff between two levels of native pasture production are the direct result of changes in infiltration. On the more productive pasture containing perennial grasses, the infiltration rate was higher because of a larger capacity for moisture storage in the topsoil, and higher rates of water movement in the subsoil. The conversion of both levels of native pasture to annual improved pasture was associated with a reduction in runoff in each case, due to increased evapotranspiration during periods when soil moisture conditions are assumed to be nonlimiting (topsoil moisture potential less than $pF 3.5$). The larger deficits developed in the soil moisture store led to increased infiltration and reduced runoff from rainfall events. The use of these findings to predict runoff, and their implications for catchment management, are discussed. (Knapp-USGS)
W70-07899

WEATHER MODIFICATION IN POPULATED AREAS,

EG and G, Inc., Bedford, Mass.
Wallace E. Howell.

In: Proceedings of the Fourth American Water Resources Conference (American Water Resources Association, Urbana, Illinois, 1968), ed. Phillip Cohen, Martha N. Francisco, p 613-622. 1 tab, 5 ref.

Descriptors: *Weather modification, *Cloud seeding, *Political aspects, *Attitudes, Droughts, Regulation, Education.

Identifiers: Weather Bureau, National Academy of Sciences, New York City, Mid-Potomac Valley, Fatalistic life outlook, Cooperative life outlook, Purposive life outlook, Familiarity.

Considerable speculation has been given to the social problems which could result from weather modification projects. In order to understand what attitudes have been expressed thus far, a fifteen case study has been compiled for all cloud seeding programs conducted between 1951 and 1965, is reviewed. All but two of these were conducted for the purpose of rain stimulation during a drought period. Of the two exceptions, one was purely experimental and the other was primarily for the purpose of hail mitigation with drought relief only a secondary objective. In all cases, with exception of the hail mitigation project, the public response was one of total indifference. It is suggested that the increased quantity of precipitation is not readily discernible. An average increase of twenty per cent is estimated from analyses to date; this was without causing an increase in the number of rainy days or producing any other recognizable abnormality in the weather. The hail mitigation project is discussed at length and opposition is described as having come from farmers who had not participated in the project and who believed that it had caused a drought. At present, no legislation curtailing weather modification has passed although a bill introduced by Representative Staggers could prohibit cloud seeding nationally. Lack of legal constraints in the public interest are suggested as producing mistrust; two social psychological studies investigating latent attitudes are also reviewed. Finally, the implications of weather modification are discussed for New York City and western New York state. (Davis-Chicago)
W70-07984

MODELS OF PRECIPITATING CUMULUS TOWERS,
Environmental Science Services Administration, Miami, Fla. Atmospheric Physics and Chemistry Lab.
Joanne Simpson, and Victor Wiggert.

Monthly Weather Review, Vol 97, No 7, p 471-489, July 1969. 17 fig, 4 tab, 60 ref.

Descriptors: *Cloud seeding, *Artificial precipitation, *Hydrometers, Cloud physics, Buoyancy, Model studies, Radar, Supercooling, Silver iodide. Identifiers: *Cumulus clouds, Maritime cloud, Autoconversion.

A model of the growth of cumulus clouds is presented. The water content and maximum height of rising towers are calculated using a buoyancy equation with consideration of effects of entrainment and water load. The latter is subject to effects of modeled microphysical effects. Precipitation growth is parameterized in terms of an autoconversion equation and a collection equation. A precipitation fallout scheme is devised that depends on water content, drop spectrum, and the vertical rise rate of the tower. Then 'freezing subroutines' are devised to model the effects of silver iodide seeding. A hierarchy of seeding routines, using different ice collection efficiencies and terminal velocities, is partially tested against the data of the Stormfury 1965 tropical cumulus-seeding experiment. Some preliminary numerical experiments on warm clouds are performed, assuming changes in drop spectra from hygroscopic seeding. (Osborne-Vanderbilt)
W70-08124

3C. Use of Water of Impaired Quality

RESEARCH ON THE UTILIZATION OF SALINE WATER FOR IRRIGATION IN TUNISIA,

Research Center for the Utilization of Saline Water for Irrigation (Tunisia).

J. M. de Forges.

Nature and Resources, Vol 6, No 1, p 2-6, March 1970. 3 tab.

Descriptors: *Saline water, *Water quality, *Irrigation water, *Irrigation effects, *Fertility, Arid lands, Semiarid climates, Irrigation, Irrigation practices, Brackish water, Land reclamation, Soil moisture, Soil properties, Soil structure, Drainage, Drainage effects, Crops, Crop production, Crop response, Rainfall, Leaching, Saline soils. Identifiers: *Tunisia, *Irrigated agriculture.

The results of Tunisia's study of saline water use for irrigation purposes is reviewed by one of the program consultants. The major emphasis of the project lay in discovering whether soil fertility in semiarid areas could be maintained when the soil was irrigated by saline water. More specifically, the study was designed to determine the effect of brackish water on soils and decide what crops can be grown on soils irrigated by saline water. Although soil salinity did increase when land was irrigated with brackish water, it was always possible to reduce salinity with little difficulty. Salinity reduction was facilitated by the good natural or artificial drainage of all the lands under study. The project also showed that although soil salinity did reduce crop yield, it was not an insurmountable difficulty. Crops were affected by other factors common to semiarid zone irrigation, such as the adverse nature of soil structure and periods of plant fragility due to excess or insufficient soil moisture. While the results of this study may be applied to other irrigated areas, it should be remembered that naturally saline soils, alkalinity, and boron contamination were not matters of concern in Tunisia and therefore were not investigated. (Carr-Arizona)
W70-07773

SURFACE IRRIGATION WITH SALINE WATER ON A HEAVY CLAY SOIL IN THE MEDJERDA VALLEY, TUNISIA,
Institute for Land and Water Management Research, Wageningen (Netherlands); and Office de la Mise en Valeur de la Basse Vallée de la Medjerda, Tunis (Tunisia).

J. A. van't Leven, and M. A. Haddad.
Netherlands Journal of Agricultural Science, Vol 15, No 4, p 281-303, Nov 1967. 8 fig, 16 tab, 11 ref.

Descriptors: *Irrigation effects, *Surface irrigation, *Irrigation water, *Clays, *Saline water, Irrigation, Irrigated land, Land reclamation, Saline soils, Semiarid climates, Salinity, Water quality, Leaching, Groundwater, Water table, Water level fluctuations, Surface-groundwater relationships, Agronomic crops, Alfalfa, Soil types, Soil texture, Soil profiles, Salt balance, Drainage, Rotations, Crop response, Climatology, Discharge (Water). Identifiers: *Tunisia, *Medjerda Valley, *Irrigated agriculture, Artichokes.

The Tunisian government, interested in reclaiming land and increasing food production in the Medjerda Valley, initiated a soil salinization study in 1962. The experiment looked at the salinization problem in terms of climatological factors, drainage, crop growth, crop rotation, saline soil, and saline water irrigation. Among the complications in attempting to farm the Medjerda area are heavy clay soils, shallow depth to saline groundwater, and the necessity of irrigating for 8-9 months of the year. The Medjerda Project is briefly described and a long list of results and conclusions of the experiment is given. (Carr-Arizona)
W70-07793

3D. Conservation in Domestic and Municipal Use

HOWELL V SEWICKLEY TOWNSHIP (SUIT TO ENJOIN OPERATION OF RESERVOIR AS TOWN WATER SUPPLY).

352 Pa 552, 43 A2d 121-127 (1945).

Descriptors: *Pennsylvania, *Reservoir operation, *Water utilization, *Municipal water, Reservoirs, Leases, Pumped storage, Reservoir storage, Water supply, Cities, Land tenure, Land use, Water rights, Land ownership, Legal aspects, Contracts, Judicial decisions, Land, Pumping, Pumps, Dams, Water storage, Remedies.

Plaintiff land owner sought a mandatory injunction against defendant township's proposed improvements of a pumping facility which was located on leased property. Plaintiff's contention, among others, was that the township's use of the water as a municipal supply constituted an unreasonable use and was a breach of conditions of the lease. The Supreme Court of Pennsylvania held that the use of the water from the reservoir as a municipal supply was not a breach of conditions of the lease and might at worst be held to be a breach of covenant. The trial court's judgment in favor of defendant was affirmed. (Barker-Florida)
W70-08021

CITY OF SYRACUSE V GIBBS (POWER OF THE STATE TO CONTROL ITS WATER RESOURCES).

283 NY 275, 28 NE2d 835-842 (1940).

Descriptors: *New York, *Water rates, *Water supply, *State jurisdiction, Water works, Judicial decisions, Legal aspects, Pipelines, Water allocation (Policy), Water conveyance, Water distribution (Applied), Water resources, Reasonable use, Administrative agencies, Administration, Legislation, Domestic water, State governments, Competing uses, Relative rights, Drainage, Usufructuary right, Utilities, Municipal water, Cities.

The State Water Power and Control Commission approved the village of Jordan's plans for the construction and operation of a municipal water system. The village was to draw its water supply from the city of Syracuse's lake source, utilizing Syracuse's water mains. Negotiation between Syracuse and the village failed to arrive at a service rate for the use of the mains. The village appealed to

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the Commission for a determination of the applicable rate. Dissatisfied with the Commission's determination, Syracuse appealed. The lower court reversed and the Commission appealed. Syracuse objected to the Commission's finding that its water supply could be appropriated by the state for other public uses. The court found exclusive dominion of the waters to be in the state. It is the state's duty to control its water resources for the benefit of all the state's inhabitants. The public right to the benefits of such resources was found to be an incident of sovereignty. The determination of the service rate was held to be a valid exercise of delegated authority to the Commission in protecting the interest of the state in its public waters. (Barnett-Florida) W70-08055

CITY OF NEWARK V PASSAIC VALLEY WATER COMM'N (RELATIVE RIGHTS OF CITIES IN DISTRIBUTION OF RESERVOIR WATER).

192 A 835-836 (NJ Ch 1937).

Descriptors: *New Jersey, *Municipal water, *Reservoirs, *Water allocation (Policy), Water demand, Water consumption, Reservoir construction, Legal aspects, Judicial decisions, Regulation, Reservoir yield, Water distribution (Applied), Water management (Applied), Water supply, Relative rights, Impounded waters, Administrative agencies, Water rights, Adjudication procedure, Contract administration, Allotments, Coordination, Local governments.

Plaintiff municipality and defendant water commission, which represented another municipality, had together constructed a reservoir. Defendant sought to sell water from the reservoir to a third city pursuant to a contract with plaintiff providing that prior to the actual consumption by plaintiff and defendant cities of their respective allotments, either municipality was at liberty to authorize the commission to dispose of the allotments on their behalf to a third city. Plaintiff sought to enjoin the sale of water to the third city alleging the contract was void without its consent to a sale and that it was inequitable to allow the third city to obtain water at less than cost. Defendant moved to strike the bill in equity. The court held that the contract between plaintiff and defendant seemed to clearly indicate that neither municipality could prevent the sale of water by the other. However, the court refused to strike the bill stating that community water supply is a matter of great public concern and, pursuant to the court's power to regulate water use, it would consider other relevant facts in a hearing. (Hubener-Florida) W70-08093

3F. Conservation in Agriculture

MEASURED AND ESTIMATED WATER USE BY A CITRUS AND AN APPLE ORCHARD, Food and Agriculture Organization of the United Nations, Tal-Amara (Lebanon); and Lebanon Agricultural Research Inst., Tal-Amara. Dept. of Irrigation Engineering.

N. Vink, A. Aboukhaled, and S. Sarraf. Magon, Serie Technique, Publication No 11, Jan 1970. 18 p, 4 fig, 5 tab, 19 ref.

Descriptors: *Water utilization, *Irrigation efficiency, *Orchards, *Citrus fruits, *Apples, Lemons, Oranges, Crop response, Irrigation effects, Timing, Irrigation practices, Irrigation, Consumptive use, Evapotranspiration, Soil-water-plant relationships, Moisture availability, Moisture stress, Moisture tension, Soil moisture, Moisture uptake, Soil water, Soil types, Saturation. Identifiers: *Lebanon, *Water use efficiency, *Irrigation requirements.

Water utilization by mature apple and citrus orchards in Lebanon was studied for a 112-day period in June-September 1969. Measured evapotranspiration (ET) for citrus ranged between

3.3 and 4.9 mm/day and reached a total of 445 mm. Total ET was estimated by the Modified Blaney Criddle formula to be 451 mm. Net seasonal (April-November) irrigation requirement for citrus was between 650 and 700 mm, given in 11 to 13 irrigations. Since the orchards grew on heavy clay soil, slight water stress under 3-week irrigation intervals was preferable to saturation of deeper soil layers by more frequent and abundant irrigation. ET for apple trees ranged from 4.9 to 7.0 mm/day. Measured ET for 61 days (1968) and 92 summer days (1969) was 373 and 480 mm respectively. ET calculated for these same periods was 336 mm and 506 mm, resulting in a relatively high deviation between measured and estimated ET. Net seasonal (May-September) irrigation requirement for apples was approximately 680 mm, given in 7 or 8 irrigations. On the deep clay soils 85-90% of total moisture extraction was from the top 1.20 m of the soil profile for apple trees and from the top 0.60 m for citrus. (Carr-Arizona) W70-07767

CONTROL OF SOIL MOISTURE DURING SPRINKLER IRRIGATION,

Utah State Univ., Logan. Dept. of Agricultural and Irrigation Engineering.

Jack Keller.

American Society of Agricultural Engineers, 1968 Summer Meeting, Logan, Utah, June 18-21 1968, Paper No 68-243. 28 p, 8 fig, 2 tab, 19 ref.

Descriptors: *Irrigation effects, *Sprinkler irrigation, *Rates of application, *Soil moisture, *Analog models, Irrigation design, Irrigation practices, Aeration, Soil structure, Soil water, Moisture content, Soil profiles, Capillary conductivity, Saturation, Infiltration, Pores, Wetting, Equations, Bulk density, Irrigation, Crop production.

When soil moisture is controlled during irrigation it is possible to maintain better soil tilth and aeration. Under sprinkler irrigation regimes the moisture content of the wetted zone of the soil profile has been found to be a function of application rate. Since aeration and tilth affect crop yields, rate of application is an important design consideration for sprinkler irrigation systems. Using a pore-channel analog, the author developed an equation which related application rate to moisture content in the transmission zone of a deep soil profile. The equation is dependent on the soil but is independent of its bulk density. Laboratory experiments on various types of soil strongly supported the equation and its associated theory. (Carr - Arizona) W70-07769

WATER STRESS AND APICAL MORPHOGENESIS IN BARLEY,

Adelaide Univ. (Australia). Waite Agricultural Research Inst.

For primary bibliographic entry see Field 02I.

W70-07770

RESEARCH ON THE UTILIZATION OF SALINE WATER FOR IRRIGATION IN TUNISIA,

Research Center for the Utilization of Saline Water for Irrigation (Tunisia).

For primary bibliographic entry see Field 03C.

W70-07773

MICROBIOLOGICAL PROBLEMS OF THE ARID ZONE,

Cornell Univ. Ithaca, N.Y. Lab. of Soil Microbiology.

M. Alexander.

Second International Conference on Global Impacts of Applied Microbiology, Interscience Publishers, No 1, p 285-291, 1969.

Descriptors: *Microbiology, *Arid lands, Diseases, Soil microorganisms, Aquatic microorganisms, Xerophytes.

Identifiers: *Applied microbiology.

The introduction of irrigation water to arid lands often creates unique problems directly or indirectly related to microbiology. Many of these have not been carefully studied. The author lists a number of areas and potential problems which would benefit from increased microbiological research: (1) Animal husbandry--problems involving nutrition and communicable diseases so that animal production per unit of land may be increased; (2) Rumen microbiology--including a survey of factors influencing rumen microflora; (3) Plant pathology--as total plant biomass increases in arid zones, indigenous pathogens become more important; (4) Groundwater recharge--particularly problems involving the production of polysaccharide plugs by bacteria; (5) Reclamation of saline soils; (6) Microbiological factors in improvement of soil structure; (7) Nitrogen production-root-nodule bacteria and symbiotic plants, and possible heterotrophic nonsymbiotic N fixation; (8) Biological control of insects. (Casey - Arizona) W70-07779

USE OF SOIL, WATER AND LEAF ANALYSES IN GROWING ORANGES IN JORDAN, Ministry of Agriculture Amman, (Jordan). Research Dept.

R. F. Allbrook.

Experimental Agriculture, Vol 3, No 3, p 215-222, July 1967. 6 tab, 12 ref.

Descriptors: *Oranges, *Soil-water-plant relationships, *Soil analysis, *Water analysis, *Irrigation water, Irrigation practices, Irrigation, Orchards, Leaves, Phosphorus, Potassium, Sodium, Chlorides, Nitrogen, Citrus fruits, Fruit crops, Standards, Arid lands, Semiarid climates, Water quality, Water types, Saline water, Salinity, Fertilizers, Fertilization, Nutrient requirements, Soil types, Saline soils.

Identifiers: *Leaf analysis, *Irrigated agriculture, *Jordan, Jordan Valley, Chlorosis.

Irrigated orange orchards in the Jordan Valley were sampled for soil, water, and leaf analyses. Most of the irrigation water was of good quality. However, use of water containing high sodium and chloride content increased the amount of these ions in the soil and caused such undesirable effects as leaf chlorosis. Soil analysis indicated that variations in soluble phosphorus and potassium ions were related to salinity of the irrigation water. Analysis of the leaves showed that chemical composition changed with age, but that the only significant difference among varieties was in potassium percentage. The author suggests standards of analysis for water, soil, and leaf composition that can be used when growing citrus. He also recommends that in order to keep soil salinity low, irrigation water class C3-S1 should not be used when annual precipitation is less than about 300 mm. (Carr - Arizona) W70-07784

GENETIC VARIABILITY IN ROOT DEVELOPMENT IN RELATION TO DROUGHT TOLERANCE IN SPRING WHEATS, Sydney Univ., Narrabri (Australia). North West Wheat Research Inst.

N. F. Derera, D. R. Marshall, and L. N. Balaam.

Experimental Agriculture, Vol 5, No 4, p 327-337, October 1969. 4 fig, 5 tab, 16 ref.

Descriptors: *Genetics, *Root development, *Drought tolerance, *Wheat, *Plant growth, Soil-water-plant relationships, Root systems, Plant breeding, Growth stages, Crop response, Drought resistance, Droughts, Moisture stress, Soil moisture, Water utilization, Evapotranspiration, Plant physiology, Plant morphology, Crop production, Grains (Crops), Cereal crops, Moisture deficit, Moisture availability, Arid lands, Semiarid climates.

Identifiers: *Australia, *Spring wheat, Water use efficiency, Jointing, Nodes.

Wheat production in northwestern New South Wales and southern Queensland is limited by the

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general drought problem, but especially by the lack of predictable precipitation during the late-winter early-spring jointing and flowering period. Since the plants are dependent on sub-soil moisture accumulate during the summer fallow period, extent of root exploration for moisture reserves would appear to be a major determinant of drought tolerance. Fifteen varieties of Australian and exotic wheat were studied for genotypic differences in drought tolerance and patterns of root development. Early maturity appeared to be the most important characteristic of tolerant genotypes and accounted for 40 to 90 percent of observed variation in drought tolerance. There were, however, measurable relationships between water use efficiency, drought tolerance, and some root development parameters. Attributes which should receive more attention in breeding studies are length per unit weight of root, amount of nodal root development, and root activity between late jointing and maturity. (Carr - Arizona)
W70-07785

CARROT POPULATION DENSITY AND YIELD IN AN ARID ENVIRONMENT, California Univ., Davis. Dept. of Water Science and Engineering.

Frank E. Robinson.

Agronomy Journal, Vol 61, No 4, p 499-500, July-August 1969. 2 fig, 3 tab, 3 ref.

Descriptors: *Carrots, *Density, *Sprinkler irrigation, *Crop production, *Arid lands, Arid climates, California, Root systems, Plant growth, Growth stages, Vegetable crops, Irrigation, Irrigation practices, Irrigation systems, Sprinkling, Size, Weight. Identifiers: *Population density, *Dry matter, *Imperial Valley.

In an experiment in the Imperial Valley of California, population density of *Daucus carota* L. cultivar 'Long Imperator No 58' was studied under sprinkler irrigation. Seeds were placed on five square grid systems, with squares of 10.2, 5.1, 2.5, 1.3, and 0.6 cm on each side. These sizes corresponded with plant densities per ha of 870,000, 3,337,000, 13,590,000, 54,390,000, and 223,050,000, respectively. Of the five densities studied, carrots on the 10.2-cm square grid produced the earliest roots of marketable size, but the least dry matter. Twenty-five days later the plants on the 5.1-cm square grid produced greater yields in dry matter and roots of marketable size. The three highest plant densities yielded even greater amounts of dry matter but produced no roots of marketable size. There was a 2:1 root-to-top ratio for the three lowest plant densities and a 1:1 ratio for the two greatest densities. Under present market criteria and the arid conditions of the Imperial Valley, it does not appear advisable to plant carrots in densities greater than 3.3 million plants per ha. (Carr - Arizona)
W70-07787

WATER RELATIONS OF BEANS; II. EFFECTS OF DIFFERENTIAL IRRIGATION ON YIELD AND SEED SIZE OF BROAD BEANS,

Khartoum Univ. (Sudan). Dept. of Agronomy.

A. H. El Nadi.

Experimental Agriculture, Vol 6, No 2, p 107-111, April 1970. 1 fig, 4 tab, 7 ref.

Descriptors: *Beans, *Irrigation effects, *Irrigation efficiency, *Crop response, *Crop production, Seeds, Irrigation, Soil-water-plant relationships, Plant physiology, Water utilization, Water requirements, Timing, Size, Agronomic crops, Plant growth, Growth stages, Evaporation, Leaves, Economic efficiency, Drought, Moisture stress, Soil moisture, Flowering, Moisture content, Arid lands.

Identifiers: *Broad beans, *Sudan, *Irrigated agriculture, *Water-use efficiency, Pods, Potential evaporation.

A crop of broad beans was grown under four different irrigation regimes in an effort to determine the most economical irrigation policy. Plants were

subjected to 'wet' or 'dry' irrigation treatments during two growth phases, resulting in wet/wet (WW), dry/wet (DW), wet/dry (WD), and dry/dry (DD) irrigation regimes. The WW treatment produced the highest yield per plot and resulted in the greatest water-use efficiency (as determined by weight of seeds per irrigation). It was also the most economically justifiable treatment, since the value of the increases seed yield was about five times the cost of the extra irrigation. The study revealed other information of interest to irrigators, such as the influence of growth stages on the effect of additional irrigation. (Carr - Arizona)

W70-07788

EFFECT OF PLANT DENSITY AND GROWTH DURATION ON GRAIN SORGHUM YIELD UNDER LIMITED WATER SUPPLY,

National and Univ. Inst. of Agriculture, Rehovoth (Israel). Volcani Inst. of Agriculture Research.

A. Blum.

Agronomy Journal, Vol 62, No 3, p 333-336, May-June 1970. 5 fig, 1 tab, 13 ref.

Descriptors: *Sorghum, *Crop production, *Limiting factors, *Density, *Water supply, Environmental effects, Arid lands, Semiarid climates, Soil moisture, Soil water, Moisture stress, Vegetation effects, Plant populations, Plant growth, Growth stages, Mature growth stage, Growth rates, Time, Competition, Grains (Crops).

Identifiers: *Israel, *Water-use efficiency, *Plant density, Hybrid sorghum.

Hybrid grain sorghum grown entirely by stored soil moisture was studied in two experiments in Israel. In one experiment, sorghum hybrids were planted in 12 densities ranging from 2.9 to 27.9 plants per square meter and grown with 302 mm available soil water. Grain yield of an early maturing hybrid was highest under high plant density and yield of the late maturing hybrid was highest under low density. These relationships were also consistent regarding yield per plant, number of heads per plant, and number of grains per panicle. The highest yield for the entire experiment was from the earliest maturing hybrid planted at the densest population. Grain yield components were suppressed by increased competition and the early maturing hybrid at highest density attained its superiority by maintaining larger grain size in spite of increased interplant competition for water. A second experiment found that water use increased with increasing plant density. An early maturing hybrid used less water at all stages of growth than a later maturing hybrid. (Carr-Arizona)

W70-07789

SOME EFFECTS OF SOIL MOISTURE STRESS ON THE GROWTH OF WHEAT (*TRITICUM AESTIVUM* L. EM THELL.),

Arizona Agricultural Experiment Station, Tucson.

A. D. Day, and Subhawat Intalap.

Agronomy Journal, Vol 62, No 1, p 27-29, Jan-Feb 1970. 3 tab, 14 ref.

Descriptors: *Wheat, *Soil moisture, *Moisture stress, *Plant growth, *Crop response, Crop production, Seeds, Grains (Crops), Growth stages, Flowering, Arid lands, Arizona, Water requirements, Water utilization, Soil water, Irrigation, Irrigation effects, Environmental effects, Cereal crops, Particle size, Soil-water-plant relationships. Identifiers: *Spring wheat, Jointing, Dough, Grain weight.

The effects of soil-moisture stress on growth and grain yield of spring wheat were studied in Arizona in 1966 and 1967. The wheat was planted in December and stressed at three different stages of development: jointing, flowering, and dough. The critical period for moisture was the jointing stage. Moisture stress at jointing resulted in earlier maturity, shorter plants, increased lodging, fewer seeds per head, fewer heads per unit area, lower grain volume-weight, and lower grain yield. Stress at any growth stage hastened maturity and decreased

grain yield. However, when wheat was stressed at jointing grain yield reduction was due to fewer seeds per head and fewer heads per unit area, while lower yields in wheat stressed at flowering or dough resulted from lighter seed-weight. In order to achieve maximum grain yield, optimum irrigation must be provided throughout the entire growing season, not just during the critical jointing stage. (Carr-Arizona)

W70-07790

EFFECTS OF SEEDING RATE AND ROW SPACING ON ESTABLISHMENT AND YIELD OF CRESTED WHEATGRASS,

Agricultural Research Service, Fort Collins, Colo. Crops Research Div.; and Colorado Agricultural Experiment Station, Fort Collins.

William J. McGinnies.

Agronomy Journal, Vol 62, No 3, p 417-421, May-June 1970. 6 tab, 9 ref.

Descriptors: *Wheatgrasses, *Range grasses, *Planting management, *Crop production, *Soil moisture, Range management, Forage grasses, Forages, Grasses, Semiarid climates, Colorado, Proteins, Moisture availability, Moisture stress, Soil-water-plant relationships, Rainfall, Weeds.

Identifiers: *Crested wheatgrass, *Seeding rate, *Row spacing, *Stand establishment, *Herbage yield, Stand survival, Seedstalk height.

In range experiments on crested wheatgrass (*Agropyron desertorum* (Fisch. ex Link) Schult.) in northern Colorado, row spacing affected herbage yield, protein content, and seedstalk height and seeding rate influenced stand establishment and survival. Rows were seeded each spring in 1960, 1961, and 1962 at the rate of 33, 66, and 98 seeds/m. As seeding rate increased there was a corresponding increase in number of seedlings per m of row, but a decline in percentage of seeds producing seedlings. When the study ended in 1967 stand survival for the 98-seed rate was significantly better than for the 33-seed rate. Row spacings of 15, 30, 46, 61, and 76 cm were also studied. Herbage yield was highest for 30 and 46-cm spacings and lowest for 76-cm spacings, but yield varied widely among spacings due to age of stand, weather conditions, and year of seeding. As row spacing widened, seedstalk height increased. Although spacing showed no effect on protein content of the 1963 harvest, percent crude protein declined in 1964 when row spacing increased. All combinations of the 3 seeding rates and 5 row spacings were tested. (Carr-Arizona)

W70-07792

SURFACE IRRIGATION WITH SALINE WATER ON A HEAVY CLAY SOIL IN THE MEDJERDA VALLEY, TUNISIA,

Institute for Land and Water Management Research, Wageningen (Netherlands); and Office de la Mise en Valeur de la Basse Vallée de la Medjerda, Tunis (Tunisia).

For primary bibliographic entry see Field 03C.

W70-07793

SOME ASPECTS OF WATER MANAGEMENT FOR CROP PRODUCTION IN ARID AND SEMIARID ZONE OF INDIA,

Central Arid Zone Research Inst., Jodhpur (India).

A. Krishnan.

Annals of Arid Zone, Vol 8, No 1, p 1-17, Mar 1969. 1 fig, 9 tab, 20 ref.

Descriptors: *Arid lands, *Semi-arid climates, *Evapotranspiration, *Moisture deficit, Irrigation programs, Climatic data, Droughts, Water loss, Consumptive use, Lysimeters, Precipitation, Agriculture, Crops, Root systems, Hydrologic budget.

Identifiers: *India, *Invisible drought, *Aridity index, Crop growing period.

In the most arid zones in India drought is permanent while in other arid and semiarid zones

there are seasonal rains. Agriculture is impossible in most areas without irrigation. The rainfall over these regions is erratic even within the rainy seasons and invisible drought may occur in which rainfall is inadequate to compensate for evapotranspirational losses. It is therefore necessary to gather adequate data to facilitate planning for suitable water management and crop planting. The arid and semi-arid zones of India are delimited in terms of land area, rainfall distribution, temperature patterns and the mean aridity index. The importance of potential and actual evapotranspiration studies is stressed and a network of lysimeters throughout the country is recommended. Estimates of moisture storage capacities of crop root zones in various soils are also needed. (Casey-Arizona) W70-07797

SPRINKLER IRRIGATION—A BIBLIOGRAPHY SELECTED FROM FOREIGN LITERATURE,
Department of the Interior, Washington, D.C.
For primary bibliographic entry see Field 10.
W70-07879

HYDROLOGICAL IMPLICATIONS OF GRASS ROOTS STUDIES AT A SITE IN EAST AFRICA,
East African Agriculture and Forestry Research Organization, Nairobi (Kenya). Physics Div.
For primary bibliographic entry see Field 021.
W70-07903

SIMULATION MODELING OF THERMAL EFFLUENT IN AN IRRIGATION SYSTEM,
Battelle Memorial Inst., Richland, Wash. Pacific Northwest Labs.
For primary bibliographic entry see Field 05G.
W70-08117

04. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on the Surface

MARR V HEMENNY (IMPOUNDED WATERS).

297 NW 504-505 (Mich 1941).

Descriptors: *Michigan, *Mill dams, *Flooding, *Impounded waters, Dams, Riparian rights, Dam construction, Judicial decisions, Legal aspects, Riparian waters, Riparian land, Flood damage, Dam design, Engineering structures, Ponds, Relative rights, Water utilization, Water law, Remedies, Prescriptive rights, Maintenance, Repairing, Water level fluctuations.

Defendants were the owners of a dam which impounded the waters of a creek. Plaintiff was the owner of riparian lands bordering on the mill pond above the dam. The wooden gates of defendants' dam became leaky and out of repair and insufficient to maintain any effective head of water. Twenty-five years later, the defendants installed steel gates in the dam which caused a rise in the pond water level and flooded part of plaintiff's lands. Prior to the dam reconstruction, plaintiff's lands had not been flooded and had been used for agricultural purposes. Plaintiff's judgment for damages and injunctive relief was affirmed by the Michigan Supreme Court. The court reasoned that the extent of a prescriptive right to cast water upon the land of another was measured by the lands actually flooded and not by the height of the dam. Consequently, defendants had no right, by means of repairs, making the dam capable of maintaining a larger head of water, to flood additional upper riparian lands. It did not matter that the dam height was not increased. (Powell-Florida)
W70-07673

EXIT GRADIENTS INTO SUBSURFACE DRAINS,

James N. Luthin, George S. Taylor, and Cesar Prieto.
Hilgardia, Vol 39, No 15, p 419-428, December 1968. 6 fig, 3 ref.

Descriptors: *Subsurface drainage, *Seepage, *Hydraulic gradient, *Drainage effects, *Soil texture, Soil density, Soil strength, Soil types, Cohesive soils, Cohesionless soils, Gravels, Sands, Sediments, Flotation, Void ratio.

Identifiers: *Quick condition, *Gravel envelopes, Kirkham's law, Soil particle weight, Surcharge load.

Water moving upward through a vertical gradient under the pressure of hydrodynamic seepage forces may cause the movement of sediments into a drain line if the soils in the vicinity of the drain line lack sufficient cohesiveness. This problem is minimal in the stable soils commonly found in the Midwest but may be quite significant in the relatively structureless soils of the western United States. The situation where by upward lifting forces create a weightless condition of the solid materials of the composite soil is known as the quick condition. In upward moving water the hydrodynamic seepage forces are opposed by gravitational forces, surcharge loads and soil cohesive forces. The resultant will determine whether a quick condition occurs. The hydraulic gradient where the seeping water emerges from the soil is called the exit gradient. A number of theoretical exit gradients into drain pipes under differing conditions of drain spacing, drain outer diameters, drain depths and drain barrier layers, were calculated using Kirkham's equation for hydraulic head potential and stream function. A flow net in the vicinity of a theoretical gravel envelope was also constructed. It was concluded that the use of a gravel envelope significantly decreases the exit gradient and therefore decreases sedimentation in the drain lines. (Casey - Arizona)
W70-07783

THE DETERMINATION OF THE DRAINAGE FACTOR AS A CRITERION FOR THE SOILS OF THE INDUS PLAINS,

International Land Development Consultants, Arnhem (Netherlands).

W. C. Hulsbos.
Netherlands Journal of Agricultural Science, Vol 16, No 1, p 25-35, Feb 1968. 5 tab, 6 ref.

Descriptors: *Drainage, *Drainage wells, *Soil texture, *Irrigation effects, *Design criteria, Irrigation, Groundwater, Recharge, Natural recharge, Water table, Water level, Aquifers, Discharge (Water), Salinity, Saline water, Evaporation, Consumptive use, Leaching, Seepage, Canals, Spatial distribution, Hydrology, Arid lands, Hydraulic conductivity.

Identifiers: *Pakistan, *Indus Plains, *Drainage factors, Irrigated agriculture, Horizontal drainage, Tubewell drainage, Leaching requirements.

In order for the cost of horizontal and tubewell drainage to be compared, drainage factors in the Indus Plains of West Pakistan had to be established for use as design criteria. The factors were calculated both from recharge estimates and from leaching requirements. The results of these two methods were compared and several types of drainage factors were distinguished. The researchers reached the following conclusions: (1) Recharge estimates yield higher drainage factors than leaching requirements. (2) Tubewell drainage will normally maintain a lower water table than horizontal drainage. (3) For tubewell drainage the factor derived from recharge estimates should be a criterion in establishing installed capacity. (4) In order to take account of seepage from line sources, a factor slightly higher than the one derived from leaching requirements should be used in calculating spacing of horizontal drainage. (5) If calculations result in wide drain spacings, the effect of intermittent recharge should be taken into account, especially in areas with any appreciable rainfall. (6) Accuracy required for drainage factors is

limited and additional data collections should concentrate on hydraulic conductivity of the soil. (Carr-Arizona)
W70-07794

BRASKO V PRISLOVSKY (ACTION TO COMPEL THE REMOVAL OF A DAM PREVENTING DRAINAGE OF WATER FROM PLAINTIFF'S LAND).

183 SW2d 925-926 (Ark 1944).

Descriptors: *Arkansas, *Ditches, *Irrigation ditches, *Repulsion (Legal aspects), Surface irrigation, Channels, Drainage, Judicial decisions, Legal aspects, Surface drainage, Highways, Drainage systems, Drainage effects, Laterals, Surface waters, Water control, Riddance (Legal aspects), Culverts, Drains, Conduits, Surface runoff, Obstruction to flow, Relative rights, Flooding, Damages.

Plaintiff and defendant owned land on opposite sides of a highway running north and south, plaintiff on the west and defendant on the east. There were ditches on both sides of the highway, parallel therewith and designed to carry away excess surface water. Defendant's predecessor on the land had dug a ditch running eastward from the highway for irrigation purposes, and defendant dug another ditch running north and south along his west line, crossing the earlier east-west ditch at a right angle. This caused the obstruction of the east-west ditch. When obstructed water which previously had drained off plaintiff's land could no longer do so. Suit was brought to compel removal of the ditch which was causing the surface waters to back up on plaintiff's lands. The court held for the defendant, stating that a landowner may fend against the flow of surface water unless in so doing he unnecessarily or willfully damages another. There was no evidence that defendant had acted willfully, and he had every right to fend against the flow of waters over his land. (Barnett-Florida)
W70-07856

SIMULATION AND HYDROLOGIC RESPONSE OF A DRAINAGE NET OF A SMALL AGRICULTURAL DRAINAGE BASIN.

Uttar Pradesh Agricultural Univ., Naini Tal (India); and Illinois Univ., Urbana.

R. A. Rastogi, and B. A. Jones, Jr.
Transactions of the American Society of Agricultural Engineers, Vol 12, No 6, p 899-908, Nov-Dec 1969. 10 p, 22 fig, 7 tab, 14 ref.

Descriptors: *Drainage basins, *Watersheds (Basins), Simulation, Model studies, *Small watersheds, Streams, Streamflow, Overland flow, Routing, Surface runoff, Hydrology, Grid systems, Channel flow, Time lag, Slopes, Storm runoff, Inflow, Outflows, *Rainfall-runoff relationships, Manning's equation.

Identifiers: *Hydrologic models, Network analysis, Runoff hydrographs, Peak runoff.

An analysis was made of the morphologic relationships on 6 small upland drainage basins in Illinois. Regression lines were fitted to data, providing relationships of total number of streams and total stream length, highest stream order and total number of streams, length and number of different order streams, average channel slope and stream order, and channel bottom width and drainage area. These relationships were used to develop a model stream net for a 5-sq-mi basin with a drainage density of 14. The kinematic formulation for one-dimensional flow was used to route overland and channel flow through the drainage network of the basic third-order stream system of the model. The model was tested using different rainfall-excess durations and intensities to explore the linear and nonlinear relationships of the hydrologic process. (USBR)
W70-07869

Field 04—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4A—Control of Water on the Surface

CHANGES IN WATER BALANCE COMPONENTS WITH PASTURE MANAGEMENT IN SOUTH-EASTERN AUSTRALIA,
Soil Conservation Authority, Kew (Australia).
For primary bibliographic entry see Field 03B.
W70-07899

FENMODE V AETNA CASUALTY AND SURETY CO OF HARTFORD, CONN (SURFACE WATERS DEFINED).

6 NW2d 479-481 (Mich 1942).

Descriptors: *Michigan, *Surface waters, *Flood damage, *Excessive precipitation, Judicial decisions, Ice, Snow, Legal aspects, Damages, Thunderstorms, Watercourses (Legal), Percolation, Evaporation, Drains, Pipes, Tides, Sewers, Rain, Discharge (Water), Ducts, Air conditioning, Leakage.

Plaintiff was the owner of a women's apparel store. Defendant was plaintiff's insurer on a water damage policy. Plaintiff's stock was damaged by reason of a heavy rainfall while being stored in plaintiff's basement. Plaintiff's policy did not cover losses due to floods, inundation, backing up of sewers or drains, influx of tides, or rising surface waters. The source of the water was the determining factor for recovery. Plaintiff claimed the damage was caused by water entering through a defective air duct, back door, and a partly opened window. Defendant claimed the damage was caused by surface waters flowing under a defective door. The court found the weight of evidence indicated that the damage was caused by surface waters, and affirmed the trial court's judgement for defendant. The court stated that surface waters are waters on the surface of the ground, usually created by ice or snow, which are of a casual or vagrant nature. They follow no definite course and have no permanent existence. (Leesfield-Florida)
W70-07900

FLOOD PLAIN INFORMATION, COASTAL FLOODING OF NORFOLK, VIRGINIA.
Corps of Engineers, Norfolk, Va.

U S Army Corps of Engineers Flood Plain Report, March 1970. 40 p, 8 fig, 7 plate, 4 tab.

Descriptors: *Floods, *Flood damage, *Virginia, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood, Hurricanes.

Identifiers: *Norfolk (Va), Standard project flood, Intermediate regional flood.

Flooding of the coastal areas of Norfolk, Virginia is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-07909

MOUNTAIN BROOK ESTATES INC V SOLOMON (LIABILITY OF SUBDIVIDER, AS BETWEEN SUBDIVIDED LOTS SOLD, FOR DRAINAGE OVERFLOW).

23 So 2d 1-7 (Ala 1945).

Descriptors: *Alabama, *Community development, *Drainage, *Riddance (Legal aspects), Easements, Surface waters, Drainage systems, Drainage practices, Water control, Closed conduits, Control structures, Culverts, Outlets, Pipelines, Sewers, Cities, Legal aspects, Judicial decisions, Overflow, Land tenure, Real property,

Relative rights, Ditches, Natural flow, Surface runoff.
Identifiers: *Servitudes.

Plaintiff servient estate owner sued the defendant corporation, the subdivider from whom he bought his property, for damages resulting from the overflow of a drainage ditch. The ditch serviced dominant estates and ran through an easement across the plaintiff's land. The lower court enjoined the defendant from allowing the overflow and required defendant to repair the drainage system. Plaintiff was also granted compensatory damages. The appellate court reversed, holding that the corporation's responsibility, to maintain the ditch it had constructed, passed to the grantees of the dominant estates at the time of such conveyances. The easement was appurtenant to and became a part of the dominant estates. Prior to said overflow, the subdivision had been incorporated into the city. The responsibility for the maintenance of the sewers then passed to the city. Moreover, the rules of law relating to the diversion of surface water were held inapplicable in that the defendant corporation, during such time as it was the owner of all the property in the subdivision, had a right to improve it, to destroy natural drains, and to provide other means for taking care of surface water thereon. (Price-Florida)
W70-07958

CITY OF PERU V CITY OF LA SALLE (RIGHT TO HAVE SURFACE WATERS NATURALLY DISCHARGED).

255 NE2d 502-507 (Ill Ct App 1970).

Descriptors: *Illinois, *Cities, *Drainage water, *Storm drains, Storm runoff, Prescriptive rights, Water rights, Surface runoff, Local governments, Legal aspects, Judicial decisions, Ravines, Natural streams, Watercourses (Legal), Drainage systems, Sewers, Outlets, Riddance (Legal aspects), Tile drains.

Plaintiff City of Peru sought an injunction to restrain defendant City of La Salle from draining water through a storm drain from the city limits of LaSalle into a ravine which ultimately drained onto property belonging to plaintiff. Plaintiff contended that in the absence of a natural watercourse draining the dominant land onto the servient land, defendant had no right to drain its land through the tile system onto plaintiff's land. Plaintiff also claimed a prescriptive right to be free from the drainage water since defendant's sewer system had drained water away from Peru for the past twenty years. The court denied the injunction stating that even in the absence of a natural watercourse, surface water may be drained into the same point of discharge where it would normally have found its way and the servient landowner cannot complain. The court also held that any prescriptive right that plaintiff asserted would be limited to the amount of water actually diverted by defendant and would not involve other surface water. Plaintiff failed to establish any such amount. (Hubener-Florida)
W70-07999

OLDENBORG V HYLEN (PROCEEDINGS FOR DRAINAGE SYSTEM TAKEN UNDER INAPPLICABLE STATUTE).

176 NW2d 78-81 (Minn 1970).

Descriptors: *Minnesota, *Drainage systems, *Legislation, *Local governments, State governments, Judicial decisions, Water law, Legal aspects, Ditches, Drainage programs, Administration, Water management (Applied), Drainage practices, Surface waters, Tiles, Drainage water, Surface runoff, Surface drainage, Assessments, Watercourses (Legal), Benefits, Real property.

Defendant county planned to improve a drainage area by constructing two ditches to drain lands previously drained only by a natural watercourse. The lands of the plaintiff, when drained only by the

natural watercourse which flowed into an older drainage system had not been assessed for benefits. Plaintiffs contended that the upstream extension of the drainage ditches, into lands not previously assessed for benefits from construction of the existing drainage system, had been taken under proceedings prescribed by an inapplicable statute. The court held for plaintiffs stating that the county had proceeded under a statute which did not permit upstream extensions of such drainage ditches. The fact that the land to be benefited by the new project was not assessed for benefits in the original project required that the county follow procedures prescribed by another statute. (Hubener-Florida)
W70-08000

TIERNEY V EARL (ALTERATION OF FLOW OF SURFACE WATERS).
172 SE2d 558-561 (W Va 1970).

Descriptors: *West Virginia, *Grading, *Surface runoff, *Surface drainage, Water spreading, Overland flow, Soil erosion, Riddance (Legal aspects), Rain water, Flood damage, Land tenure, Landfills, Land use, Retaining walls, Land development, Land forming, Judicial decisions, Legal aspects, Relative rights, Alteration of flow, Obstruction to flow, Remedies, Damages.
Identifiers: Adjoining landowners.

Plaintiffs and defendant were adjoining home owners in a residential subdivision. One plaintiff alleged that the defendant, in grading his property, caused dirt to be piled on his side of the boundary line to a height of six to eight feet above the natural terrain. Defendant replied that excavations by the plaintiff in building his home had deprived defendant's property of lateral support and demanded relief. The other plaintiff, whose land also adjoined defendant's land, alleged that defendant had changed and raised the grade on another part of his lot so that the natural flow of surface waters on plaintiff's property was impeded. As a result, plaintiff suffered recurring flooding of his lot. The court held for both plaintiffs, and ruled that defendant was required to remove the dirt spilled on the first plaintiff's property. The court also ordered plaintiff to construct a retaining wall of sufficient height and strength to provide lateral support for defendant's property. Defendant was also ordered to remove the piled dirt which impeded the natural flow of surface waters from the other plaintiff's land. (Hubener-Florida)
W70-08001

ESCHETE V CITY OF NEW ORLEANS (FLOOD DAMAGES CAUSED BY INADEQUATE DRAINAGE SYSTEM).

231 So 2d 725-727 (La App 1970).

Descriptors: *Louisiana, *Cities, Drainage systems, *Storm runoff, Local governments, Storm drains, Urbanization, Utilities, Drainage water, Surface waters, Water control, Flood control, Precipitation (Atmospheric), Excessive precipitation, Rain, Storms, Flood damage, Damages, Judicial decisions, Adjudication procedure, Sewage systems, Construction.

Plaintiffs were homeowners in a subdivision area which, in times of heavy rainfall, experienced severe flooding due to defective and inadequate drainage systems. Plaintiffs alleged the city knew of the defects and failed to make improvements. Plaintiffs also alleged that, despite this knowledge, the city had authorized further construction of subdivisions in the area, thus greatly increasing the drainage problem. The court held the complaint insufficient since the city had no control over the drainage system and the flooding had occurred in the same area prior to authorization of further subdivision construction. The court pointed out that the co-defendant, the Sewerage and Water Board which controlled drainage systems, had the characteristics of a corporation, including the capacity to sue and be sued, and did not dismiss the suit against the Board. (Hubener-Florida)

Control of Water on the Surface—Group 4A

W70-08002

BRADLEY V TEXACO, INC (DIVERSION OF SURFACE WATERS BY MEANS OF LAND-FILL).

172 SE2d 87-90 (N C Ct App 1970).

Descriptors: *North Carolina, *Eembankments, *Surface runoff, *Landfills, Land tenure, grading, Retaining walls, Slopes, Slope protection, Soils, Surface waters, Surface drainage, Riddance (Legal aspects), Judicial decisions, Legal aspects, Relative rights, Damages.

Plaintiff and defendant were adjoining landowners. Defendant oil company constructed a fill on its land to make it suitable for building a service station thereon. Plaintiff brought action for alleged damage to her property resulting from dirt, water and other debris washing down the embankment constructed by defendant. The lower court held for plaintiff. The appellate court acknowledged the principle that owners of land on a higher level cannot divert or interfere with the natural flow of surface water to the injury of servient owners without incurring liability. However, the court reversed and ordered a new trial since the lower court had refused to give permanent damages to plaintiff but had allowed testimony which constituted evidence of permanent damages in addition to testimony indicating amount of damages sustained by plaintiff up to the time of the trial. Since the evidence of permanent damage could have influenced the jury in assessing the amount of damage, the court ordered a new trial. (Hubener-Florida)

W70-08004

KEY SALES CO V SOUTH CAROLINA ELECTRIC AND GAS CO (DAMAGES CAUSED BY RELEASE OF WATER FROM DAM).

422 F2d 389-390 (4th Cir 1970).

Descriptors: *South Carolina, *Federal Power Act, *Dams, *Peak discharge, Hydroelectric plants, Damages, Water control, Water storage, Legislation, Electric power, Flood plains, Floods, Flood damage, Discharge (Water), Floodwater, Legal aspects, Judicial decisions, Relative rights, Water law, Riparian rights, Flooding, Flood protection, Land development, Excessive precipitation.

Plaintiff real estate developer sued defendant owner of hydroelectric dam when water released from the dam during a period of heavy rainfall caused damage to his lands. The court held for defendant ruling that plaintiff was not entitled to damages where the peak discharge of water from the dam did not exceed the peak flow of water into the dam during the storm. The court also found that the plaintiff developer's land lay in the flood plain of the river, had experienced flooding in previous years, and would have been flooded during the storm if the dam had not been in existence. The court also denied recovery for the damage under the Federal Power Act since the power company was not obligated by state law or federal license to operate its dam as a flood control facility for the benefit of lower riparian owners. (Hubener-Florida)

W70-08010

PETROVICH V UNITED STATES (SUIT FOR DAMAGES TO OYSTER BEDS ARISING FROM CHANNEL DREDGING).

421 F2d 1364-1370 (Ct Cl 1970).

Descriptors: *United States, *Louisiana, *Channels, *Dredging, Channel improvement, Excavation, Channel flow, Oysters, Commercial shellfish, Spoil banks, Damages, Silting, Silts, Sedimentation, Federal government, Remedies, Judicial decisions, Legal aspects, Erosion, Beds under water, Local governments, Engineering.

Plaintiff oyster growers brought action against the United States for damages to oyster beds caused by dredging of a channel. The dredging had taken

place as a result of the Barataria Bay Waterway project authorized by Congress in 1958. Plans for the project, which included dredging by bucket dredge and construction of spoil banks, had been reviewed by state and local officials prior to commencement of the project, and the parish council and the state of Louisiana had executed assurances that the United States would be held harmless on liability claims for damages. As a result of the project, plaintiff's oyster beds suffered damage from increased silt accumulation. It was conceded that plaintiff was injured, so the measure of damages was the only remaining question. The United States Court of Claims applied a reasonable standard of damages on the ground that earlier oyster suits had shown actual damages impossible to determine. The collateral issue of the United States' attempted joinder of the local parish council was dismissed. (Barker-Florida)

W70-08013

THOMPSON V DYAR (CONSTRUCTION OF LEVEE ALONG CREEK CONTESTED BY LOWER RIPARIAN OWNER).

130 NE2d 52-54 (App Ct Ind 1955).

Descriptors: *Indiana, *Obstruction to flow, *Levees, *Natural flow, Natural watercourses, Riparian rights, Relative rights, Natural flow doctrine, Judicial decisions, Streambeds, Surface runoff, Streams, Dams, Damages, Floods, Proprietary power, Channels, Banks, Bank protection, Flooding, Repulsion (Legal aspects), Prescriptive rights, Remedies.

Identifiers: Injunctions (Mandatory).

Defendant constructed a levee extending one-quarter of a mile alongside a stream flowing through his property. Plaintiff, a lower riparian owner, sought an injunction requiring the defendant to remove the levee, alleging that it altered the natural course of the stream and caused an increase in the flow of water over plaintiff's lands. The circuit court entered judgment for defendant and the appellate court affirmed, stating that the levee had no effect on flowage of the creek water either in flood stage or low water stage. The court stated, as an analogy, that a lower proprietor may erect levees of reasonable height to prevent surface waters from entering his land, and he cannot be held liable for damages, if the obstruction causes water to flow on lands of another, unless the levee changes a natural or prescriptive course or channel. As there was no change in the course or amount of flow in the creek, the court refused to order removal of the levee. (Hubener-Florida)

W70-08020

TOWN OF HAMBURG V GERVASI (PREScriptive EASEMENTS; SURFACE WATER).

55 NY S2d 876-878 (Sup Ct 1945).

Descriptors: *New York, *Prescriptive rights, *Surface drainage, *Easements, Natural flow doctrine, Adjudication procedure, Boundaries (Property), Community development, Drainage districts, Judicial decisions, Legal aspects, Land tenure, Local governments, Proprietary power, Public benefits, Repulsion (Legal aspects), Riddance (Legal aspects), Surface waters, Surface runoff, Relative rights, Remedies, Watercourses (Legal).

Identifiers: Injunctions.

Plaintiff city sought an injunction allowing it to enter defendant's land for the purpose of keeping open a watercourse and thus allowing for the free passage of drainage water. Plaintiff contended that from time immemorial surface waters had drained from upper lands across defendant's land, and the effect of such drainage had been to create a natural watercourse. In the alternative, plaintiff contended that it had acquired a prescriptive easement to drain surface waters across defendant's land. The court found the testimony insufficient to warrant the finding of a natural watercourse. Furthermore,

the mere fact that surface water had always flowed from the land of the upper owner across defendant's land, without any other facts shown, would not give rise to a prescriptive easement. (Clarke-Florida)

W70-08022

FREIDEN V WESTERN BANK AND TRUST CO (SEWERS; PREScriptive EASEMENTS).

50 NE2d 369-372 (Ohio Ct App 1943).

Descriptors: *Ohio, *Easements, *Sewers, *Prescriptive rights, Subsurface drains, Conduits, Legal aspects, Right-of-way, Drainage systems, Controlled drainage, Drainage water, Cities, Land tenure, Conveyance structures, Land use, Real property, Judicial decisions, Relative rights, Benefits, Beneficial use.

Identifiers: *Servitudes.

Plaintiff acquired a lot by deed of general warranty from defendant bank. Plaintiff sued the bank and eight adjoining landowners to determine the status, rights, and duties of the parties with respect to a certain sewer, unmentioned in the deed, traversing all of said lots. All of the adjoining lots had at one time belonged to a common grantor who had constructed the sewer. The court found a sewer easement appurtenant to each lot and created by implication. The court held that implied grants of easement, although not favored, may be found on the basis of the following: (1) a severance of unity of ownership in an estate; (2) the use being shown to have been of a permanent nature before separation of ownership occurs; (3) the easement being reasonably necessary to beneficial engagement of the land granted; and (4) the servitude being continuous. The court further held that easements visible only on close inspection, such as underground drains, may pass by implied grant where the use is strictly necessary and the common owner intended the use to become appurtenant to the property benefited. (Hubener-Florida)

W70-08023

WILL V BOLER (OBSTRUCTION TO FLOW IN DRAINAGE DITCH CONSTRUCTED BY BOTH UPPER AND LOWER OWNERS).

4 NW2d 345-348 (Minn 1942).

Descriptors: *Minnesota, *Surface drainage, *Obstruction to flow, *Repulsion (Legal aspects), Runoff, Surface waters, Drainage, Surface runoff, Flow, Channels, Overflow, Land tenure, Ditches, Construction, Dams, Land, Maintenance, Damages, Benefits, Legal aspects, Judicial decisions, Landfill, Watercourses (Legal), Remedies, Relative rights.

Plaintiff upper landowner sought an injunction restraining defendant lower landowners from damming a ditch which aided the natural drainage of surface water from the area. The ditch had been constructed with contributions from predecessors in interest to the affected lands, including plaintiff's predecessor. Defendants filled part of the ditch, causing much of the surface runoff to overflow plaintiff's land. Plaintiff prevailed at the trial and defendants appealed on two grounds: (1) that evidence was insufficient to show a natural watercourse where the ditch ran; and (2) that evidence was insufficient to show plaintiff's predecessor contributed to the ditch's construction. The Minnesota supreme court affirmed the decision. The evidence supported both the finding that the ditch was constructed along a natural depression for surface drainage and that plaintiff's predecessor contributed to its construction. The Minnesota rule is that landowners may rid themselves of surface water but may not unreasonably or unnecessarily injure their neighbors in doing so. It is also the rule that where neighboring landowners unite to construct a drainage ditch to improve their holdings, each is estopped from closing the ditch in a way depriving others of the drainage. Defendants' acts

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were unreasonable and injured plaintiff. A mandatory injunction restraining defendants was the proper remedy. (Duss-Florida)
W70-08024

LARSON V BUSSE (DRAINAGE SYSTEMS; EMINENT DOMAIN; COMPENSATION).
295 NW 47-53 (Minn 1940).

Descriptors: *Minnesota, *Eminent domain, *Drainage systems, *Local governments, Public benefits, Legal aspects, Judicial decisions, Surface waters, Riddance (Legal aspects), Streams, Tiles, Drains, Ditches, Outlets, Land tenure, Drainage effects, Compensation, Condemnation value, Riparian rights, Water law, Condemnation, Easements.
Identifiers: *Police power, Servitudes.

Defendant's land contained a slough which he wanted to drain in order to cultivate the ground. Defendant proceeded to construct a ditch to convey the water across the lands of the plaintiffs. The local township had authorized the construction under its drainage regulations and, by exercise of its eminent domain power, required subservient landowners (plaintiffs) to receive the drainage water. Plaintiffs sued for compensation. The court noted that under common law a landowner may direct surface waters onto adjoining lands as long as he does not cause unreasonable injury. However, under eminent domain powers, adversely affected landowners are entitled to compensation for all damages. The dissent stated that the township had exercised its police power in permitting the drainage, and benefiting the public thereby, and, therefore, no compensation was required. (Hubener-Florida)
W70-08030

GOODWIN V TEXAS CO (DUTY TO REMOVE CONTINUING NUISANCE).

185 A 695-696 (Me 1936).

Descriptors: *Maine, *Obstruction to flow, *Flood damage, *Abatement, Flooding, Damages, Watercourses (Legal), Flood control, Judicial decisions, Legal aspects, Remedies, Encroachment, Landfills, Regulation, Water injury, Construction.
Identifiers: *Nuisance (Continuing).

In former proceedings defendant corporation was found to have obstructed a natural watercourse in such a manner as to cause salt water and flooding damage to the lands and properties of plaintiffs. Plaintiffs were awarded damages as a result of such obstruction. However, the nuisance was not abated, and plaintiffs brought this action to recover further damages. Defendant maintained that plaintiffs' recovery in the prior suits represented the permanent damage and, therefore, this action could not be maintained. The court held successive suits could be brought for a nuisance where permanent damages cannot be ascertained. The general principle of law was stated that upon the creation of a nuisance, the creator may be legally compelled to remove it. For failing to so remove, defendant was found liable for damages resulting as of the date of filing suit in the prior suits up to the date of filing suit in the present action. (Finman-Florida)
W70-08032

WHEELER V TAYLOR (RIGHTS TO CONTINUED WATER FLOW).

39 A2d 190-193 (Vt 1944).

Descriptors: *Vermont, *Dams, *Easements, *Water use, Water supply, Water rights, Land use, Floodgates, Legal aspects, Judicial decisions, Mills, Saw mills, Mill dams, Riparian rights, Obstruction to flow, Alteration of flow, Relative rights, Remedies.

Defendant was the owner of a dam and flashboards on a pond upstream from plaintiff's saw mill. Plain-

tiff's grantor had owned both the mill and dam but had transferred only the former to plaintiff. The mill had burned down, and was inoperative at the time plaintiff purchased it. Defendant purchased the dam and surrounding land after plaintiff had rebuilt the mill and had resumed using the water as a source of power. Following a personal quarrel, defendant spiked the dam's flashboards in place and refused to allow the plaintiff access to the water. Plaintiff brought action to enjoin defendant's interference with this access. Plaintiff claimed that an implied easement had arisen from the deed of his grantor. The Supreme Court of Vermont pointed out that implied easements are created by reservation or grant and that only the latter might be applied to the instant case. The necessity of an easement was cited as an important but not determinative factor. The court held that since the mill was inoperative at the time of plaintiff's grant, there was no need for the water and thus no grant of an easement to obtain it. The trial court's judgment for the defendant was affirmed. (Barker-Florida)
W70-08034

STROUGH V CONLEY (DIVERSION OF STREAMS--CONTRACT TO SUPPLY WATER).
164 Misc 248, 298 NYS 516-531 (Sp Ct 1937).

Descriptors: *New York, *Municipal water, *Supply contracts, *Water supply, Local governments, Water consumption, Water works, Water control, Utilities, Contracts, Legal aspects, Land tenure, Alteration of flow, Diversion, Riparian rights, Streamflow, Water utilization, Reservoirs, Water demand, Judicial decisions.

Plaintiff village had diverted streams into a reservoir for municipal use which previously flowed across the lands of defendants. The village agreed with defendants' predecessors in title to supply water to their premises. The supply to defendants was always inadequate and the village terminated the supply when it began to acquire its water from a nearby city. Plaintiff village brought this action to restrain defendants from interfering with the return of stream water to its original course and for a decree authorizing the plaintiff to abandon its objection and be relieved of any damages once the water was returned to its original course. In holding for defendants, the court ruled that the agreement with defendants' predecessors in title was a continuing obligation until defendants were restored to their original condition. Defendants held the same right as their predecessors and were entitled to damages for the previous inadequate service and for as long as the village diverted the stream water without supplying another source to defendants. However, damages for loss of revenue in defendant's dairy production were held to be based only on conjecture and surmise and was not allowed. (Hubener-Florida)
W70-08037

CERA V CONSOL WATER POWER CO (FLOODING CAUSED BY RAISING OF DAM HEIGHT BEYOND AGREED LEVEL).
276 NW 124-126 (Wisc 1937).

Descriptors: *Wisconsin, *Dams, *Water levels, *Height, Flood damage, Overflow, Riparian rights, Damsites, Reservoirs, Dam construction, Barriers, Legal aspects, Judicial decision, Water law, Land use, Water storage, Water works, Utilities, Water sources, Relative rights, Contracts, Impoundments, Damages, Impounded waters.

Defendant maintained a dam across a river along which plaintiff owned land. Defendant and plaintiff reached an agreement by which defendant was allowed to flood a certain portion of plaintiff's land. Defendant subsequently raised the height of the dam 3 1/2 feet and plaintiff, in a suit for damages, contended that defendant had, by impounding more water, exceeded the extent of flooding permitted in the grant. The court, construing the agreement and a certain diagram recorded with it,

found that the newly flooded land did not come within the original agreement and held for plaintiff. The plaintiff was entitled to damages equal to the difference in value of the land before and after the flooding caused by raising the dam. (Hubener-Florida)
W70-08039

KING V BROWN (DRAINAGE DITCH; PRESCRIPTIVE RIGHT).
298 Ky 485, 183 SW2d 490-492 (1944).

Descriptors: *Kentucky, *Ditches, *Easements, *Prescriptive rights, Drainage systems, Right-of-way, Legal aspects, Surface waters, Water control, Excavation, Trenches, Judicial decisions, Contracts, Benefits, Obstruction to flow, Remedies, Surface runoff, Runoff, Relative rights, Contracts, Real property, Excessive precipitation, Land tenure.

Plaintiff made a contract with an adjoining landowner authorizing construction of a ditch across the land of the adjoining owner. The ditch was constructed to carry off water which collected on plaintiff's lands and overflowed onto the adjoining land in times of heavy rainfall. Defendant, who purchased the adjoining land, filled in the ditch with rocks and debris and obstructed drainage flow, claiming that the ditch had not been constructed in accordance with the contract. Plaintiff sought an injunction ordering removal of the obstructions. The court held for the plaintiff stating that the existence and usage of the ditch for a period exceeding 10 years constituted compliance with the contract. Since defendant had been informed of the contract and the ditch before purchasing, he had knowledge of the easement right and could not complain of the insufficiency of the ditch. (Hubener-Florida)
W70-08040

HONEY V BERTIG (CASTING FLOOD WATER ON ADJACENT LANDS).
150 SW2d 214-216 (Ark 1941).

Descriptors: *Arkansas, *Drainage systems, *Overflow, *Relative rights, Ditches, Natural flow doctrine, Levees, Channels, Conduits, Structures, Conveyance structures, Controlled drainage, Judicial decisions, Legal aspects, Streams, Streamflow, Embankments, Alteration of flow, Drainage districts, Excessive precipitation, Floods, Floodwater, Damages.

Identifiers: Adjacent landowners, Scraper ditches.

Plaintiff and defendant were adjoining landowners in the same drainage district. A drainage ditch which tended to overflow in heavy rains, ran across their lands in a southeasterly direction. Plaintiff and defendant dug an additional scraper ditch to the south which ran across their lands and led into the drainage ditch. During floodwaters the drainage ditch overflowed into the scraper ditch. Defendant constructed a levee along the scraper ditch to prevent it from overflowing onto his lands to the south. Plaintiff sought an injunction for removal of the levee alleging that the levee cast the overflow waters onto his lands to the northwest. In holding for defendant the court acknowledged that a lower proprietor may not cast the waters of a natural stream upon lands of the upper proprietor to his injury. The court did not decide whether floodwaters constituted a natural stream or whether they were merely surface waters which could be thrown upon adjoining lands. However, the court did hold that the floodwater was a common enemy, and consequently defendant was entitled to protect his land unless, in doing so, he caused unnecessary injury to others. (Hubener-Florida)
W70-08042

JOHANNSEN V OTTO (DRAINAGE FLOW ACROSS ADJACENT LAND INCREASED BY

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ARTIFICIAL DRAINAGE SYSTEM).

282 NW 334-336 (Iowa 1938).

Descriptors: *Iowa, *Drainage systems, *Surface drainage, *Natural flow, Drainage water, Drainage effects, Flood control, Overflow, Runoff, Surface waters, Surface runoff, Overland flow, Flow control, Water conveyance, Judicial decisions, Legal aspects, Water law, Tiles, Tile drainage, Construction, Relative rights, Damage, Routing.

Plaintiff owned a 100 acre tract of land on which, to expedite the natural flow of drainage water into a nearby creek, he constructed an artificial tile drainage system. Plaintiff sold 80 acres to defendant and retained a low-lying tract of 20 acres through which all the drainage water passed before entering the creek. Defendant permitted an adjoining landowner (second defendant) to construct a drainage system which tied into his own. Plaintiff sought damages and an injunction against the added flow, alleging that it caused his own system to overflow and damage the 20-acre tract. The court refused damages and the injunction on the basis of a state statute authorizing, as long as the system followed the natural course of drainage, construction of drainage systems to permit the collection and flow of water from one owner's land to another's. Here water flowing through the drainage system across plaintiff's land followed a natural course of flow. The court found the damage very slight, occurring only during heavy rainfall, and not attributable to the extra drainage. (Hubener-Florida)
W70-08046

WILLIS V PHILLIPS (SERVIENT ESTATE NOT ENTITLED TO HAVE CULVERT REMOVED TO PREVENT DRAINAGE ACROSS ITS LANDS).

2 So 2d 732-734 (Fla 1941).

Descriptors: *Florida, *Culverts, *Prescriptive rights, *Riddance (Legal aspects), Drainage water, Engineering structures, Overflow, Floods, Surface runoff, Drainage, Natural flow, Obstruction to flow, Remedies, Judicial decisions, Legal aspects, Ditches, Drainage effects, Routing, Flow control, Overland flow, Cities, Local governments, Roads.

Drainage water from a high area of land was collected in and flowed along a ditch paralleling a road. The water then flowed through a culvert maintained by defendant county commissioners and across lands of plaintiff into a pond. Plaintiff, alleging that the water flooded his land and damaged his crops, sought an injunction to require removal of the culvert. Plaintiff contended that for several years water had flowed in the ditch along the road without being directed across his land and that he had acquired a prescriptive right to have the water continue to flow only in the ditches along the road. The court, upon a finding that the natural course of flow was across plaintiff's land toward the pond, denied the request for the injunction. Drainage water cannot be prevented from following a natural course of flow. The court also found that the flooding on plaintiff's land was due to his attempts to obstruct the drainage flow, and that the flooding would be eliminated by construction of a ditch across his land. (Hubener-Florida)
W70-08044

LARE V YOUNG (DISCHARGE OF SURFACE WATER ONTO ADJOINING LAND).

153 Pa Super 28, 33 A2d 662-664 (1943).

Descriptors: *Pennsylvania, *Surface waters, *Surface drainage, *Surface runoff, Judicial decisions, Relative rights, Legal aspects, Natural flow doctrine, Easements, Natural flow, Cities, Runoff, Seepage, Obstruction to flow, Property values, Real property, Land tenure, Remedies, Reasonable use.

Plaintiff and defendant were owners of adjoining lots in a subdivision. Defendant's lot was of higher elevation than plaintiff's land. Plaintiff contended that the grading of defendant's lot and the construction of a driveway changed the natural contour of the lot and increased the normal volume of surface water flowing onto his property. Plaintiff sought an injunction and damages. In holding for defendant, the court stated that the owner of a lot in a city acquires land subject to the condition that existing surfaces are liable to be changed by the course of municipal development. An owner has a primary right to protect himself against the flow of surface water but may not collect and discharge surface water in a body and cause unnecessary injury. However, an owner may take reasonable measures to protect himself and incidental losses to neighbors are damnum absque injuria. The court found no evidence of a material diversion or increase of surface waters from defendant's property or any evidence of damage to plaintiff's property. (Hubener-Florida)
W70-08046

DARDENNE REALTY CO V ABEKEN (CONSTRUCTION OF DAM CONTESTED BY LOWER RIPARIAN OWNER).

106 SW2d 966-970 (St Louis Ct App Mo 1937).

Descriptors: *Missouri, *Diversion dams, *Natural streams, *Watercourses (Legal), Alteration of flow, Judicial decisions, Obstruction to flow, Diversion, Natural flow doctrine, Riparian rights, Relative rights, Dam construction, Flow control, Channel flow, Riparian land, Ditches, Rivers, Natural flow, Proprietary power, Lakes, Streams, Surface drainage, Prescriptive rights, Artificial watercourses, Impoundments.

Plaintiff was the owner of a large tract of land containing 2 lakes. The lakes were fed by a stream which also passed through defendants' land before entering plaintiff's land. The defendants constructed a dam across the stream to collect and divert the water into artificial lakes on their own land. Plaintiff sought an injunction against interference with the usual flow of water in the stream and for removal of the dam and closure of diversion ditches. Since the year of trial was particularly dry and there was little flow in the stream, it was necessary to determine whether the stream was a natural watercourse. The appellate court accepted the trial court's finding that, since the creek had a definite channel and its flow was not due only to surface drainage, the creek was a natural watercourse. The court also found that the action of a prior owner in raising one bank of the stream had not changed the stream into an artificial watercourse. Moreover, even if artificial, riparian rights could be acquired by prescription. The injunctions ordering removal of the dam and cessation of the diversions were affirmed. (Hubener-Florida)
W70-08047

TOWN OF BOONTON V STATE WATER POLICY COMM'N (REVIEW OF AGENCY DECISION CONCERNING DAM CONSTRUCTION).

122 NJL 34, 4 A2d 62-64 (1939).

Descriptors: *New Jersey, *Dams, *Reservoirs, *Administrative agencies, Permits, Administrative decisions, Cities, Public health, Water resources development, Structures, Damsites, Water storage, Water control, Water supply, Remedies, Judicial decisions, Legal aspects, Flooding, Water rights, Land use, Real property, Prescriptive rights, Swamps, Swimming, Flooding.

Plaintiff city sought review of defendant commission's decision granting a permit for a dam. The purpose of the dam, to be located on a stream which served as part of the municipal water supply, was to eliminate a swamp. Plaintiff alleged that creation of a reservoir in the designated location would endanger public health. It was also contended that defendant had improperly interfered with plaintiff's prescriptive right to flood the land

of the party granted the permit. In dismissing the appeal, the Supreme Court of New Jersey pointed out the strict set of controls imposed by the commission to regulate the reservoir and foreclose the chance of pollution. Numbering eight in all, the conditions included swimming regulation, sewage safeguards, chlorination provisions, and various regulatory rights vested in the commission. The court held that the dam would ultimately result in a public benefit and that the commission's decision in no way effected property rights in the land where the reservoir would be situated. (Barker-Florida)
W70-08048

SMITH V ORBEN (INCREASED WATER FLOW IN STREAM).

182 A 153-156 (NJ Ch 1935).

Descriptors: *New Jersey, *Natural flow, *Drainage systems, *Relative rights, Riparian rights, Alteration of flow, Reasonable use, Water law, Flow, Streams, Upstream, Downstream, Drainage, Surface waters, Overflow, Drainage effects, Drainage engineering, Legal aspects, Remedies, Judicial decisions.

Plaintiffs, property owners, sought a mandatory injunction against defendant upstream property owner prohibiting the continued discharge of drain water into a stream which flowed through their properties. Defendant had developed his land so as to increase the accumulation of rain water and melted snow, and the discharge of these accumulations through a system of drainage so increased the flow of the stream that material damage was done to the properties of the downstream property owners. The court recognized the general rule that a property owner may collect surface water and discharge it into a natural water-course thereby increasing the volume and speed of the normal flow, but only to the point where the natural capacity of the stream is not exceeded so as to materially injure the lower riparian owner. It was held in the instant case that defendant had not acted within this general rule. The court did not issue the requested injunction, however, but rather instructed defendant that he should take immediate action to prevent further damage to plaintiff's property. (Barker-Florida)
W70-08052

COVELL V SIOUX CITY (EXCAVATION FOR CHANNELING OF STREAM AS AFFECTING LATERAL SUPPORT FOR ADJACENT LAND).

277 NW 447-451 (Iowa 1938).

Descriptors: *Iowa, *Percolating water, *Excavation, *Channeling, Groundwater, Groundwater movement, Reasonable use, Penetration, Underflow, Underseepage, Ditches, Streams, Land tenure, Land use, Real property, Water law, Judicial decisions, Legal aspects, Seepage, Banks, Embankments, Permeability, Structures.

Plaintiff and defendant were adjoining landowners. A natural stream ran through defendant's lot and defendant dug a new channel for it, excavating the ground to within several feet of plaintiff's lot. Plaintiff in a suit for damages claimed that the partial destruction of the lateral support for her property, due to the fact that water from the creek was enabled to percolate through the ground under her home, caused her house and sidewalks to settle and crack. The court stated that an adjoining landowner has the right to excavate up to boundary lines of adjoining territory, taking reasonable precautions to assure that adjoining soil does not fall from its own pressure. The excavating owner is liable if adjoining soil falls from its own pressure but is not liable if it falls due to the pressure of structures on the adjoining land. The court held that there was no evidence in support of the contention that water from the creek percolated under plaintiff's house. Therefore, the rule establishing the liability of a landowner who collects water and allows it to seep through the ground to the injury of adjoining landowner did not apply. (Hubener-Florida)
W70-08053

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CARRABIS V BROOKLYN ASH REMOVAL CO (LIABILITY FOR DAMAGES RESULTING FROM SURFACE RUNOFF). 291 NYS 841 (App Div 1936).

Descriptors: *New York, *Surface runoff, *Relative rights, *Landfills, Storm runoff, Overland flow, Runoff, Environmental sanitation, Environmental engineering, Garbage dumps, Public health, Land forming, Sanitary engineering, Waste disposal, Land use, Flow, Surface waters, Surface drainage, Riddance (Legal aspects), Slopes, Rodents, Legal aspects, Judicial decisions.

Plaintiff and defendant were adjoining landowners. Defendant filled in lower land on his property with ashes and garbage so that his property was of greater height than plaintiff's land. As a result, water ran off defendant's property onto the premises of plaintiff in greatly increased quantities. Plaintiff brought this action for damages. In holding for defendant the court ruled that the filling-in operation was not an illegal act since it had not resulted in the creation of a defined watercourse or altered an existing one. Plaintiff was not entitled to damages for this particular cause although other nuisances created by defendant in the filling operation might warrant nominal or substantial damages. (Hubener-Florida)

W70-08054

TOWN OF BOONTON V FAY (TOWN SOUGHT TO HALT CONSTRUCTION OF DAM AND DEVELOPMENT OF ARTIFICIAL LAKE). 130 NJ Eq 55, 21 A2d 364-366 (1941).

Descriptors: *New Jersey, *Developed waters, *Land development, *Dams, Prescriptive rights, Reservoirs, Water pollution sources, Riparian rights, Public health, Public rights, Lakes, Impoundments, Watercourses (Legal), Potable water, Water quality control, Water utilization, Local governments, State governments, Permits, Administrative agencies, Regulation, Relative rights. Identifiers: *Injunction (Prohibitory).

Plaintiff town sought to restrain defendant's construction of a dam. The purpose of the dam was to form a lake, following which defendant planned to develop the land around it. Plaintiff contended that: (1) the dam would create a source of pollution endangering the town's water supply; (2) the dam would diminish the flow of water into the town's reservoir; (3) the statute authorizing the permit was unconstitutional; (4) the dam would interfere with the prescriptive right of the town to overflow a portion of defendant's lands. The court, in determining whether a cause of action was stated, held that although potability of water was a primary consideration when the New Jersey Water Pollution Commission granted permits for dam construction, the issue of pollution had been decided in an earlier proceeding in favor of defendant. However, the issue of diminution of water supply had been previously heard and plaintiff could raise its common law right as a lower riparian owner. The constitutionality question had also not been raised previously and could be heard in the injunction proceeding. The alleged prescriptive rights of the town had not been raised in prior proceedings and the equity court had jurisdiction to consider those rights. (Hubener-Florida)

W70-08057

WHITCHER V STATE (RIGHT OF DAM OWNER TO CONTROL WATER LEVEL OF A POND). 181 A 549-556 (NH 1935).

Descriptors: *New Hampshire, *Impounded waters, *Riparian rights, *Mill dams, Ponds, Judicial decisions, Natural flow, Recreation, Reasonable use, Riparian land, Dam construction, High water mark, Water level fluctuations, Low water mark, Streamflow, Prescriptive rights, Water rights, Public benefits, Swimming, Fishing, Structures, Artificial use.

Defendants were owners of lots on the shore of a pond. Plaintiff owned a mill on the stream issuing from the pond. Plaintiff's predecessor in title had erected a dam on the pond and stream 70 years before, raising the water level of the pond 7 feet. Plaintiff reduced the water level of the pond in order to begin repairs on the dam, but defendants sought to restrain him. Plaintiff brought this action for determination of his rights. Defendants claimed that the plaintiff was only entitled to the natural flow over the dam and could not lower the water level by opening the gate in the dam. They also claimed a right by dedication to enjoy the artificial high water mark of the pond for swimming purposes. The court found that plaintiff had never intended to dedicate such a right and determined that plaintiff held a prescriptive right to use the flowage of the pond. The court further held that plaintiff was entitled to utilize the pond water down to the natural low water mark as long as the water was used as a source of power for his mill. However, the use could not be capricious or malicious with respect to interests in the pond of the riparian owners. Plaintiff could not be estopped from lowering the water level by the mere fact that cottages had been built around the pond during a period when the water was maintained at a high level. (Hubener-Florida)

W70-08062

TOWN OF PURCELLVILLE V POTTS (REASONABLE USE AND DIVERSION OF WATERS FROM A NATURAL STREAM). 19 SE2d 700-704 (Va 1942).

Descriptors: *Virginia, *Dams, *Alteration of flow, *Reasonable use, Obstruction of flow, Diversions, Judicial decisions, Legal aspects, Channels, Streams, Riparian rights, Riparian waters, Impoundments, Riparian land, Natural flow doctrine, Competing uses, Domestic water, Municipal water, Easements, Prescriptive rights, Relative rights, Discharge (Water), Diversion structures, Flow control, Eminent domain, Cities.

A spring-fed stream ran through plaintiff's land in a well-defined channel. Defendant city constructed dams on the stream above plaintiff's property, diverted the water from its natural channel and piped it into the city for the use of its inhabitants. Plaintiffs sought a mandatory injunction to abolish the dams and for damages for the diminution of the value of their property caused by defendant's actions. The court held that since both plaintiff and defendant were riparian owners, each had an equal right to the reasonable use of the water, but neither could diminish its quantity materially to the prejudice of lower proprietors. Defendant's diversion of the water beyond its riparian land was extraordinary and was not a reasonable use. Moreover, the use of the waters of a stream by a municipality is not a riparian right and a municipality can be held civilly liable for diverting waters and depriving lower riparian owners of the use thereof. However, the court here allowed the municipality to bring condemnation proceedings to obtain the riparian rights of plaintiffs to carry out their municipal purpose of obtaining a water supply for its inhabitants. (Hubener-Florida)

W70-08064

TACKETT V LINNENBRINK (RIGHT TO DIVERT SURFACE WATERS). 112 SW2d 160-164 (Ct App Mo 1938).

Descriptors: *Missouri, *Watercourses (Legal), *Diversion, *Repulsion (Legal aspects), Judicial decisions, Legal aspects, Natural streams, Alteration of flow, Diversion structures, Natural flow doctrine, Reasonable use, Relative rights, Riparian rights, Riddance (Legal aspects), Surface waters, Surface runoff, Drainage, Competing uses.

Plaintiff filed suit seeking damages for the alleged diversion of waters upon his land by defendant's negligent construction of a dam across an alleged watercourse that traversed their lands. Plaintiff contended there was a regular watercourse on his

land with a definite channel having a bed and sides or banks. However, defendant argued that only surface waters that come upon this land passed across it and onto the adjoining land of plaintiff. From a trial court judgment for defendant, plaintiff appealed. The court stated that the general rule is that one may not divert or obstruct a watercourse so as to injure his neighbor's land. However, the court also stated that a dominant owner of land has a right to improve and protect his real estate by protecting it from surface water. Surface waters are a common enemy which every landowner may resist without liability. Since the question of whether or not certain water is surface water is a fact question for the jury, the court affirmed the trial court's judgment for defendant. (Barnett-Florida)

W70-08065

CLARK V PIERCE (RIGHT TO UNOBSTRUCTED NATURAL SURFACE DRAINAGE). 277 NW 711-712 (Iowa 1938).

Descriptors: *Iowa, *Surface drainage, *Surface runoff, *Obstruction to flow, Drainage systems, Drainage effects, Overflow, Runoff, Surface waters, Overland flow, Ditches, Routing, Flow control, Water conveyance, Natural flow, Artificial watercourses, Judicial decisions, Legal aspects, Alteration of flow.

Plaintiff and defendant were adjoining landowners. Plaintiff constructed a drainage system which directed surface waters across defendant's land. The system did not function effectively and plaintiff, without permission, entered defendant's land and dug a ditch to assist drainage flow. Defendant then placed railroad ties and fenceposts in the ditch. Plaintiff, in this action, sought an injunction to restrain defendant from interfering with the flow of water in the ditch. The court acknowledged that the owner of a dominant estate has the right to have surface waters accumulating on his land flow unobstructed in the natural course of drainage upon a servient estate. In holding for defendant, the court stated that the ditch was artificial and defendant was entitled to place the posts in it as long as he did not restrain the flow of water over his land more than it was impeded before the ditch was constructed. (Hubener-Florida)

W70-08069

DI NARDO V DO VIDIO (RIGHT OF DRAINAGE THROUGH ARTIFICIAL DITCH ON ANOTHER'S LAND). 45 NE2d 269-272 (Mass 1942).

Descriptors: *Massachusetts, *Ditches, *Obstruction to flow, *Natural flow, Spring waters, Alteration of flow, Relative rights, Springs, Discharge (Water), Streams, Judicial decisions, Legal aspects, Water law, Diversion, Flow control, Overflow, Drainage, Drainage practices, Watercourses (Legal), Prescriptive rights, Damages, Land tenure. Identifiers: *Servitudes.

Plaintiff and defendant were adjoining landowners. Water from a spring on plaintiff's land flowed in a natural course through ditches running across the land of defendant and into a culvert. At an unknown time on defendant's land a newer ditch had been constructed which branched off the main course and carried water directly to the culvert, avoiding two right angle turns in the older course of flow. Water flowed through both branches before reaching the culvert. Defendant closed the newer ditch on his land causing water to rise on plaintiff's land since the old right-angled course did not provide sufficient drainage. Plaintiff sought damages and an injunction to open the newer ditch. The court refused to require the opening of the newer ditch, holding that the newer ditch did not constitute the normal course of flow of the water. A landowner cannot subject the land of another to a servitude of running water to which it is not naturally subject. The court also held that plaintiff had not acquired a right of drainage through the newer

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ditch by adverse use. However, the court held plaintiff was entitled to have the older ditches cleaned and awarded plaintiff nominal damages. (Hubener-Florida)
W70-08075

STEED V KIMBROUGH (OVERTAXING OF LOWER OWNER'S DRAINAGE BY IMPROVEMENTS ON UPPER LANDS).

19 So 2d 925-927 (Miss 1944).

Descriptors: *Mississippi, *Surface runoff, *Repulsion (Legal aspects), *Riddance (Legal aspects), Surface waters, Flow augmentation, Alteration of flow, Diversion, Drainage, Drainage practices, Drainage systems, Flow control, Water control, Relative rights, Surface drainage, Rainfall - runoff relationships, Overland flow, Precipitation excess, Rain water, Ditches, Drainage effects, Natural flow, Judicial decisions, Legal aspects, Flooding.

Plaintiff and defendant were owners of adjoining land. Surface water naturally flowed from the defendant's unimproved upper land onto the plaintiff's lower land. The defendant constructed ditches through his upper lands and drained the surface water into a drainage ditch which the plaintiff had constructed along the common boundary. The accelerated flow and increased concentration of water overtaxed the plaintiff's ditch during heavy rains, and some water backed up onto the defendant's property. To force the plaintiff to improve his ditch, the defendant cut into the ditch and caused periodic flooding of the plaintiff's land. The plaintiff sought to enjoin the defendant, and the court held that the lower land owner, while ridding himself of naturally accumulated surface water, cannot use the upper land or cause water to back up in amounts greater than would be on the upper owner's property under natural conditions. However, neither can the upper owner create conditions, as was here done, which increase the flow onto the lower owner's land beyond that amount which would naturally flow thereon. If the upper owner creates such a situation, he must take care of the excess flowing back onto his property. (Price-Florida)
W70-08079

NALL V STATE (RIGHT TO DAMAGES FOR CASTING COLLECTED SURFACE WATER ONTO ADJOINING LAND).
33 NYS2d 1006-1007 (Ct Cl 1942).

Descriptors: *New York, *Surface runoff, *Riddance (Legal aspects), *Landfills, Drainage water, Concrete structures, Surface drainage, Rainwater, Earthworks, Land forming, Drains, Diversion structures, Diversion, Legal aspects, State governments, Land use, Alteration of flow, Real property, Damages, Relative rights, Impounded waters, Obstruction to flow, Remedies.

Plaintiff and the defendant state were adjoining landowners. Plaintiff placed fill upon a part of his land and also upon a part of the state's land. This fill caused the diversion of water after it left the end of a concrete gutter located on defendant's land. Without such fill water would have run from the gutter over state lands, passing plaintiff's property, and into a brook. Plaintiff sought damages for the diversion of water from the state lands to his property. The court acknowledged the rule that a landowner is entitled to recover where an adjoining owner collects surface waters and casts them upon his neighbor's property. However, the court held that here it was plaintiff's own action in placing the fill that caused the water to run from state land to plaintiff's land. (Hubener-Florida)
W70-08081

WRIGHT V CITY OF ONEONTA (MUNICIPAL LIABILITY FOR DAMAGES CAUSED BY OVERFLOWING STREAM).
165 Misc 492, 1 NYS2d 295-300 (Sup Ct 1937).

Descriptors: *New York, *Flood damage, *Excessive precipitation, *Alteration of flow, Local governments, Adjudication procedure, Judicial decisions, Legal aspects, Relative rights, Riparian land, Riparian rights, Riparian waters, Usufructuary right, Watercourses (Legal), Flood control, Dams, Flashfloods, Overflow, Cloudbursts, Rainfall, Floods, Intensity, Maximum probable flood, Diversion, Swimming pools.

A stream, to which the city had the water rights for the purpose of supplying the city residents, flowed through defendant city. During a particularly severe rainstorm, the stream overflowed its banks and the overflow damaged plaintiff's buildings and property. Plaintiff sued the city on the grounds that the city was obligated to maintain the stream within its banks and that, in altering the channel of the stream, defendant had failed to protect the rights of lower landowners. Evidence showed that defendant had for a short distance diverted the waters out of the natural channel in order to form a swimming pool. The water was then diverted back into the channel. The court held that a municipality through which a stream flows has no duty to keep it in a safe condition or free from obstruction not of its own causing, nor is it liable for damages from increased flow of surface water so long as the water is not diverted from its natural course. In this case the evidence did not warrant a finding that defendant had changed or increased the hazard from the stream in question. The conditions which caused the flood were unusual, extraordinary and unforeseeable. (Clarke-Florida)
W70-08083

WHITMAN V FORNEY (OBSTRUCTION OF DRAINAGE PIPE WHICH REPLACED DITCH).
31 A2d 630-634 (Md 1943).

Descriptors: *Maryland, *Pipes, *Easements, *Riddance (Legal aspects), Reasonable use, Highways, Administrative agencies, Drainage practices, Outlets, Subsurface drainage, Ditches, Drainage engineering, Open channels, Judicial decisions, Legal aspects, Surface runoff, Clay pipes, Pipelines, Drainage water, Obstruction to flow, Prescriptive rights, Repairing, Roads, Relative rights, Natural flow.

Defendants blocked off a ditch carrying surface waters from a state road across their land. Plaintiff state road commission acquiesced in the filling of the ditch since a pipeline replaced the ditch as the means of drainage. The pipeline later broke and obstructed drainage from plaintiff's road. Plaintiff brought suit to enjoin defendants' obstruction to the drainage and to require defendants to restore the drainpipe to its original condition. The court held that the owner of upper land has a right to the uninterrupted flowage of water, and the proprietor of lower land, to which the water naturally descends, has no right to obstruct such flowage. The right to flowage exists without regard to a prescriptive easement. However, the court found that although plaintiffs were entitled to flowage over defendants' land, since plaintiff had acquiesced in the filling of the ditch with a pipeline, plaintiff was not entitled to compel defendants to maintain the line at their own expense. Plaintiff was entitled only to go upon defendants' land to repair the drain. (Barnett-Florida)
W70-08087

DARR V CAROLINA ALUMINUM CO (DAMAGE TO LAND AND CROPS RESULTING FROM OBSTRUCTION OF DRAINAGE FLOW).
3 SE2d 434-437 (NC 1939).

Descriptors: *North Carolina, *Drainage, *Watercourses (Legal), *Riddance (Legal aspects), Open channels, Judicial decisions, Legal aspects, Easements, Surface drainage, Ditches, Surface waters, Ponding, Dams, Channels, Prescriptive rights, Streams, Rivers, Banks, Trenches, Discharge (Water), Artificial watercourses, Surface runoff, Obstruction to flow, Silting.

Plaintiffs brought an action against defendant for the recovery of damages to land and crops. Plaintiffs alleged that defendant's negligent construction of a dam across the Yadkin River above plaintiffs' lands had caused the channel of the river to be filled with sand, debris and vegetation. This in turn caused its tributary streams that flowed over plaintiffs' lands to be obstructed. These obstructions allegedly prohibited the natural flow into the tributaries of drainage waters from ditch on plaintiffs' lands. The court held that evidence failed to show that the obstructed ditch was a natural watercourse, defined as a ditch consisting of banks, beds and water while in a state of nature without artificial construction. Without such a showing plaintiffs did not have the legal right to collect the water on their land and discharge it through such ditch over the lands of defendant. The fact that plaintiffs had no other means of discharge did not give them such a right. Also, under the laws of North Carolina, the permissive use of the ditch for thirty years did not give plaintiffs an easement to continue such use. (Barnett-Florida)
W70-08090

LOUISVILLE AND NASHVILLE RR V CAP-DEPON (DUTY TO REMOVE OBSTRUCTION TO NATURAL FLOW OF SURFACE WATERS).
4 So 2d 544-546 (Miss 1941).

Descriptors: *Mississippi, *Obstruction to flow, *Ditches, *Drainage, Construction, Damages, Surface waters, Slopes, Railroads, Drainage effects, Drainage engineering, Drainage patterns (Geologic), Drainage practices, Drainage systems, Drainage water, Legal aspects, Judicial decisions, Flow, Flow control, Flow resistance, Natural flow, Maintenance, Repairing.

Defendant railroad company constructed a railroad and a ditch adjacent to plaintiff's lot. The ditch was constructed to carry surface waters from plaintiff's lot since the railroad obstructed the natural flow of drainage. When the ditch was kept clear and free of debris, it would properly drain the water from plaintiff's land. However, the ditch became clogged by grass, tree tops and other debris. As a result, water backed up onto plaintiff's property. Defendant made no attempt to remove the obstructions. Plaintiff brought action for damages to his lot and the improvements thereon which resulted from this flooding. The court held that defendant not only had the duty to properly construct the ditch but also to properly maintain it so as not to obstruct the natural flow of surface waters from plaintiff's land. Consequently, defendant was liable for any damages incurred by plaintiff as a result of such obstruction. (Finman-Florida)
W70-08116

TOWN OF YORK V MCALPIN (DUTY TO DISCONTINUE WRONGFUL DIVERSION OF WATER).
2 Div 70, 167 So 539 (Ala 1936).

Descriptors: *Alabama, *Local governments, *Overflow, *Diversion structures, Surface drainage, Structures, Judicial decisions, Legal aspects, Remedies, Abatement, Flow control, Surface waters, Drainage systems, Damages, Watershed management, Regulation, Regulated flow, Standards, Design standards, Management, Culverts, Alteration of flow, Diversion.
Identifiers: *Nuisance, Injunction (Prohibitory).

Plaintiff private landowner brought action against defendant municipality for an injunction, damages, and the abatement of a nuisance caused by defendant's construction of pipes or culverts so that they caused surface waters to be wrongfully diverted and to overflow onto plaintiff's property. The court found that the manner in which the culverts were installed and maintained caused plaintiff's damages. Therefore, the court rendered judgement for plaintiff for the abatement of the nuisance and for damages. The injunction was granted as a necessary protection to plaintiff against the constant or frequently recurring injuries due to the

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wrongful diversion of surface waters. The court found that damages alone could not provide an adequate remedy because of the nature of plaintiff's injury. (Clarke-Florida)
W70-08127

4B. Groundwater Management

GROUNDWATER CONTAMINATION,
Guelph Univ. (Ontario). Dept. of Soil Science.
For primary bibliographic entry see Field 05B.
W70-07766

DOES ARTIFICIAL GROUND WATER RECHARGE CONTAMINATE OUR GROUND WATERS,
Texas Tech Univ., Lubbock. Dept. of Agricultural Engineering; and Purdue Univ., Lafayette, Ind. Dept. of Agricultural Engineering.
Marvin J. Dvoracek, and Rolland Z. Wheaton.
Agricultural Waste Management Conference, Cornell University, Typescript, January 1970. 19 p, 32 ref.

Descriptors: *Artificial recharge, *Groundwater, *Groundwater recharge, *Ecology, *Water pollution, Waste water disposal, Aquifers, Water supply, Water management (Applied), Water spreading, Pit recharge, Recharge wells, Balance of nature, Environment, Environmental effects.

The authors describe the methods of artificial groundwater recharge and raise the question of whether artificial recharge contaminates groundwater. They feel that no clearcut answer is available, but they hope to stimulate research and evaluation on planned and operational artificial recharge installations. In the past, severe groundwater contamination has generally been localized. However, the potential for widespread contamination is quite real and the authors fear it may already be occurring. Any damage may upset the total ecological system of the universe by the phenomena of biological amplification. Augmentation of the water supply by artificial recharge should not be considered so important as to openly invite the use of contaminated recharge water. (Carr - Arizona)
W70-07771

THE DETERMINATION OF THE DRAINAGE FACTOR AS A CRITERION FOR THE SOILS OF THE INDUS PLAINS,
International Land Development Consultants, Arnhem (Netherlands).
For primary bibliographic entry see Field 04A.
W70-07794

ANTICIPATIONS OF CHANGE: A SOCIO-ECONOMIC DESCRIPTION OF A KENTUCKY COUNTY BEFORE RESERVOIR CONSTRUCTION,
Kentucky Water Resources Inst., Lexington.
For primary bibliographic entry see Field 06B.
W70-07994

VANDERBILT V STATE (DESTRUCTION OF WELL'S WATER SUPPLY).

159 Misc 586, 288 NYS 544-545 (Ct Cl 1936).

Descriptors: *New York, *Subsurface waters, *Road construction, *Water wells, Wells, Underground streams, Underground, Groundwater, Relative rights, Springs, Subsurface investigations, Excavation, Civil engineering, Construction, Soil mechanics, Highways, Highway effects, Judicial decisions, Legal aspects.

Defendant state, in the construction of a highway, cut through a subterranean stream and rendered useless the well of plaintiff who owned land adjacent to the construction site. Plaintiff sought compensation for the taking of private property

and damages. The court found that the highway was constructed in conformity with usual plans, specifications, and accepted engineering methods and the state had no knowledge of the existence of the subterranean stream. The court held that since no property of plaintiff had been taken, he was not entitled to any damages in the absence of negligence or knowledge of the stream's existence. (Hubener-Florida)
W70-08027

4C. Effects on Water of Man's Non-Water Activities

EFFECT OF URBANIZATION ON STORM WATER PEAK FLOWS,
Pedro C. C. Da Costa.
ASCE Proceedings, Journal of the Sanitary Engineering Division, Vol 96, No SA 2, Paper 7198, p 187-193, April 1970. 7 p, 1 fig, 3 ref, append.

Descriptors: *Rainfall-runoff relationships, *Urbanization, *Storm runoff, *Peak discharge, Hydrograph analysis, Rational formula, Drainage, Precipitation intensity, Watersheds (Basins), Frequency analysis, Storm drains, Time of concentration.
Identifiers: Urban watersheds.

Urbanization of a natural watershed modifies the original shape and proportions of the hydrograph that may be considered representative of the natural watershed. The unique runoff coefficient of the rational formula is, in fact, the product of three factors, each one having some correlation with the degree of urbanization given to the watershed. The influence of urbanization is mainly expressed by the degree of imperviousness and the degree of artificial canalization given to the watershed. The presented general rational formula is related to other rainfall-runoff relationships derived by Snyder and by Horner-Flynt. Results from the formula are compared with those obtainable by the Chicago Method. The concepts presented must be considered as one way of demonstrating the relationship between rainfall and runoff in areas which are urbanized or not, rather than a completely developed and tested method of calculating storm water peak flows. (Knapp-USGS)
W70-07671

A HYDROMETEOROLOGICAL STUDY RELATED TO THE DISTRIBUTION OF PRECIPITATION AND RUNOFF OVER SMALL DRAINAGE BASINS - URBAN VERSUS RURAL AREAS,
Texas A and M Univ., College Station. Water Resources Inst.

Robert G. Feddes, Robert A. Clark, and R. C. Runnels.

Available from the Clearinghouse as PB-192 635, \$3.00 in paper copy, \$0.65 in microfiche. Technical Report No. 28, June 1970. 64 p, 5 tab, 27 fig, 20 ref. OWRR Project A-010-TEX (1).

Descriptors: *Rainfall-runoff relationships, Surface runoff, Rainfall, *Urbanization, Precipitation (Atmospheric), Texas, *Streamflow, *Watersheds (Basins), Hydrograph analysis, Meteorology.
Identifiers: Bryan (Tex).

The effects of urbanization on streamflow are investigated for two adjacent similar watersheds located in and near Bryan, Texas. The Burton Creek watershed is 84 per cent urbanized and the Hudson Creek watershed is completely rural. Storms observed within each basin are used for comparison of pertinent hydrograph parameters. Simultaneous events are compared between the watersheds and the urbanization effect noted. A synthetic procedure for predicting hydrographs on both watersheds is developed. Reproduction of actual events indicates better results in the rural watershed. There is conclusive evidence that the

urbanization of a watershed decreases time-to-peak and increases the peak discharge.
W70-07980

SIMPLIFICATION OF INTEGRATED STORMWATER PLANNING FOR MODERN, MULTIPLE LAND USE IN URBAN AND SUBURBAN DEVELOPMENTS,
Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.

B. M. Reich.
Available from the Clearinghouse as PB-192 750, \$3.00 in paper copy, \$0.65 in microfiche. Project Completion Report, March 31, 1970. 11 p, 8 tab, 30 fig, 40 ref, 2 append. OWRR Project B-010-PA (1).

Descriptors: *Storm runoff, *Flood routing, *Flood control, *Synthetic hydrology, *Urbanization, *Planning, Design flood, Headwaters, Computer programs, Floodways, Reservoir operation, Grassed waterways, Water management (Applied), Watershed protect, Flood prevent.
Identifiers: Return period, *Urban hydrology, Downstream hydrograph, Grassed valley bottoms, Blue and green concept.

Four synthetic hydrograph methods were applied on five watersheds in hopes of simplifying planning decisions for reserved space in valley bottoms of suburban headwaters. Both hydrograph and routing procedures were programmed for digital computer evaluation for the more than 300 cases considered. General conclusions include the following. (1) No simple rules can be given on width of floodways to planners. Each case must be individually investigated. (2) Computer methods greatly facilitate routing and synthetic hydrograph computations. (3) Generalizations are impossible because interactions occur between the method used, the return period, and the percentage of the watershed above the reservoir among others. (4) A great need exists for data-based methods for predicting suburban design hydrographs in ungauged situations. (5) A new course on urban hydrology was developed from the studies results. The course is designed to teach hydrologists the modern techniques which are being developed to solve this set of urban problems. (Sink-Penn State Univ)
W70-07981

REPUBLIC STEEL CORP V STRACNER (DAMAGE TO WELLS CAUSED BY MINING OPERATIONS).

21 So 2d 690-693 (Ala 1945).

Descriptors: *Alabama, *Mining, *Overlying proprietor, *Damages, Adjudication procedure, Boundaries (Property), Judicial decisions, Land tenure, Leases, Legal aspects, Proprietary power, Relative rights, Groundwater, Remedies, Drainage effects, Wells.
Identifiers: *Mineral rights.

Defendant corporation owned mineral rights to land adjoining and under plaintiff's property. Evidence indicated that defendant had operated mines under plaintiff's property and that, in retreating from such mines, defendant had removed pillars supporting the roof of the mines. As a result, the land superjacent to the mine shafts caved in, causing a nearby percolating well on plaintiff's land to dry up. Plaintiff sued for loss of property value. The court held that miners are strictly liable for damages caused by disturbances of land from mining operations. A miner, however, is not liable for incidental damages necessarily occasioned by ordinary and careful operation of a mine, and not injurious to the surface, such as the loss of wells by the superjacent owner. But if such wells are willfully or negligently drained without reasonable need to do so, causing damage to the surface owner, there is a cause of action. The court held that defendant's failure to properly support the abandoned mine shafts constituted such a cause of action, and affirmed the trial court's judgement for plaintiff. (Clark-Florida)

Sources of Pollution—Group 5B

W70-07982

VANDERBILT V STATE (DESTRUCTION OF WELL'S WATER SUPPLY).

For primary bibliographic entry see Field 04B.

W70-08027

THE CLIMATE OF CITIES,

For primary bibliographic entry see Field 02B.

W70-08121

RECENT STUDIES OF URBAN EFFECTS ON PRECIPITATION IN THE UNITED STATES,
Illinois State Water Survey, Urbana.

Stanley A. Changnon, Jr.

American Meteorological Society Bulletin, Vol. 50, No. 6, p 411-421, June 1969. 2 fig, 4 tab, 39 ref.

Descriptors: *Precipitation (Atmospheric), *Cities, *Climatology, Thunderstorms, Hail, Thermal pollution, Rain gages, Frequency, Snowfall, Condensation, Orography.

Identifiers: *Urban-induced nuclei.

Very little research has been conducted dealing with urban effects on precipitation. However, the few studies which have been conducted reveal from 5 to 16% increases in precipitation and from 7 to 20% increases in summer thunderstorm days in urban areas. Even greater increases in precipitation have been observed downwind from major steel mill complexes. These changes have been credited to urban-induced nuclei concentrations and urban thermal effects. The results of the urban studies may indicate the effectiveness of ground-based seeding, the possibility of successful increases in all seasons, the likelihood of thunderstorm and hail-storm increases with rainfall increases, and the need for dense rain gauge networks to adequately determine the area and amount of increase. (Osborne-Vanderbilt)

W70-08126

05. WATER QUALITY MANAGEMENT AND PROTECTION**5A. Identification of Pollutants****RESEARCH NEEDS ON THERMAL AND SEDIMENTARY POLLUTION IN TIDAL WATERS,**

F. D. Masch.

ASCE Proceedings, Journal of the Hydraulics Division, Vol 96, No HY7, Paper 7426, p 1539-1548, July 1970. 10 p, 7 ref.

Descriptors: *Tidal waters, *Estuaries, *Water pollution effects, *Water pollution sources, *Research facilities, Water temperature, Water pollution, Tidal effects, Sediments, Hydraulics.

Identifiers: *Research needs, *Estuarine pollution, Tidewater.

When requested to identify the most pressing research need in its field, the ASCE Tidal Hydraulics Committee quickly arrived at the consensus opinion that thermal and sedimentary pollution of tidal water bodies was the major problem. Over a period of a year valuable ideas and suggestions have been obtained from all committee members. Sedimentary and thermal pollution problems in tidal water are described and the literature and some related research are reviewed. General and specific research needs in both thermal and sedimentary pollution, as well as instrumentation, are outlined. (Knapp-USGS)

W70-07656

FALLOUT AND CLIMATE STUDIES ON FIRN CORES FROM CARREFOUR, GREENLAND,
Innsbruck Univ. (Austria); and Copenhagen Univ. (Denmark). H. C. Orsted Inst.
W. Ambach, and W. Dansgaard.

Earth and Planetary Science Letters, Vol 8, No 4, p 311-316, May 1970. 6 p, 3 fig, 1 tab, 16 ref.

Descriptors: *Fallout, *Glaciers, *Tracers, *Tritium, *Profiles, Climatology, Tracking techniques, Regimen, Arctic, Stable isotopes, Radioisotopes. Identifiers: Greenland, Oxygen isotopes.

To compare detailed, vertical gross beta-activity and tritium profiles in a high polar glacier with a temporal record of fallout of fission products at high latitudes, to compare the annual net accumulation data that might be derived from the radioactivity and stable isotope profiles, and to estimate the recent climatic development on the mid-Greenland ice sheet, two snow and firn cores, 20 meters apart, were hand augered at Station Carrefour on the Greenland ice sheet. Only little summer melting and no runoff occur in the area. Both of the ice cores were cut into 10-15 cm long increments. The longer core, representing the upper 20 m, was analyzed for gross beta-activity and oxygen isotope ratios; the short core, reaching from 1 to 10 m below surface, was analyzed for tritium and oxygen isotopes. None of the beta-activity and O-18 profiles is quite sufficient for establishing a reliable isotopic identification of recent annual snow layers at Carrefour. However, such identification can be obtained in the period 1953-65 by comparing the two profiles mentioned, or by comparing the beta-activity profile with exactly dated fall-out data from nearby stations. The use of the beta-activity measurements is limited to strata formed since 1953. (Knapp-USGS)

W70-07667

TECHNOLOGY AND ECONOMICS OF SEWAGE TREATMENT (IN GERMAN),
M. Kehren.

CIBA-Runschau, No 130, p 2-34, 1957.

Descriptors: *Self-purification, *Iron, Economics, Waste water treatment, *Sewage treatment, Sewage, Sewage effluents.

Identifiers: *Chemical composition, *Textile mill wastes, Sewage condition, Iron salts, Dyeing wastes, Plant design, Niers process, Pista process.

A series of short illustrated articles deals with regard to the condition of sewage and waste waters discharged to streams; processes of self-purification and the organisms concerned; amount and chemical composition of waste waters from textile, leather, and paper works; processes and plant for the treatment of waste waters; the use of iron and iron salts in the treatment of waste waters containing dyestuffs; the design of modern plants for the treatment of very polluted waste waters by the Niers process and the Pista process; and plant and operation costs. (Livengood-North Carolina State)

W70-07730

API RECOMMENDED PRACTICE FOR ANALYSIS OF OIL-FIELD WATERS.

American Petroleum Inst., Dallas, Tex. Div of Production.

For primary bibliographic entry see Field 02K.

W70-07908

SWAP CHEMICALS FOR CLEANER STREAMS,
Wesleyan Univ., Middletown, Conn.

For primary bibliographic entry see Field 05B.

W70-07972

APPLICATIONS OF FLUORESCENT TRACER TECHNIQUES IN POLLUTION CONTROL STUDIES,

Beak (T.W.) Consultants Ltd., Montreal (Quebec).

For primary bibliographic entry see Field 05G.

W70-08100

DETERMINATION OF NITRATE IN WATERS WITH THE NITRATE-SELECTIVE ION ELECTRODE,
Wisconsin Univ., Madison. Dept. of Soils.

For primary bibliographic entry see Field 07B.

W70-08105

WOOL INDUSTRY WASTE WATERS (IN RUSSIAN),
For primary bibliographic entry see Field 05D.

W70-08140

5B. Sources of Pollution**GOOD HOUSEKEEPING IS BEST SOLUTION TO STREAM POLLUTION,**
Massachusetts Inst. of Tech., Cambridge.
R. E. McKinney.

American Textile Reporter, Vol 71, p 71-74, 1957.

Descriptors: *Water pollution, *Waste waters, *Pollution sources, *Water pollution effect, Waste waters, Water conservation, Test procedures, Inorganic waste.

Identifiers: *Process chemicals, *Effluent treatment, Waste water analysis, Absorption capacity (Stream).

The textile industry contributes to three basic types of pollution: (1) materials having a high oxygen demand, (2) inorganic matter, and (3) color. The major textile waste problem results from the organic fractions in their process wastes. Greater emphasis is needed on water conservation and water pollution; the textile industry must become concerned with these problems. Although few mills have the properly trained personnel and/or proper equipment, if plant managers will consider carefully the following 10 specific areas, water can be more readily conserved and pollution can be better controlled: (1) The pollution absorption capacity of the stream. (2) Sources of pollution within mill. (3) Volume of water used and pollutive characteristics. (4) Good housekeeping reduces pollution to minimum. (5) Process changes or process chemical changes. (6) Waste treatment is last resort. (7) Chemical treatment for colloidal or suspended pollution. (8) Biological treatment for soluble wastes. (9) Evaluation of each type of treatment. (10) Separate treatment versus combined treatment. The proper consideration of each of these steps will result in the most economic solution to textile mill waste treatment problems. (Robinson-North Carolina State)

W70-07756

GROUNDWATER CONTAMINATION,
Guelph Univ. (Ontario). Dept. of Soil Science.
Robert W. Gillham, and L. R. Webber.
Water and Pollution Control, Vol 106, No 5, p 54-57, May 1968. 5 fig, 1 tab, 11 ref.

Descriptors: *Groundwater, *Piezometry, *Water table, *Surface-groundwater relationships, *Water pollution sources, Infiltration, Wastes, Hydraulic conductivity, Subsurface drainage, Transmissivity, Head loss, Darcys law, Time lag, Nitrogen compounds, Nitrates, Discharge measurement, Discharge (Water), On-site data collections, Underflow.

Identifiers: *Hydraulic potential, Canada.

All inorganic salts of N are very soluble in water and N in the nitrate form is particularly hazardous for both humans and livestock. Barnyards and feedlots may be prime sources of inorganic N in groundwater. A piezometric network was installed radially throughout a barnyard for determination of groundwater discharge out of the barnyard so that it could be correlated with the changes in the N concentration of the water as it passed beneath the barnyard. The active head of water in a given piezometer was measured at different times. Its basic time lag, together with the geometry of the piezometer, could be used to calculate hydraulic conductivities from a large number of sites. These were then used to construct a map of isopotential lines indicating changes in hydraulic potential with distance. A simplifying assumption was that hydraulic potential did not vary vertically in the

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water table to bedrock. Together with N measurements at various depths to bedrock, the results showed that the barnyard contributed 0.00189 lb N/hr to the groundwater, or about 17.5 lb N/yr. This was considered surprisingly low, since the manure of a single cow could produce 74 lb N/yr. (Casey-Arizona)
W70-07766

DOES ARTIFICIAL GROUND WATER RECHARGE CONTAMINATE OUR GROUND WATERS?

Texas Tech Univ., Lubbock. Dept. of Agricultural Engineering; and Purdue Univ., Lafayette, Ind. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 04B.
W70-07771

SWAP CHEMICALS FOR CLEANER STREAMS,

Wesleyan Univ., Middletown, Conn.
N. W. Masselli, and M. G. Burford.
Textile Industries, Vol. 125, No. 2, p120-144, 1961. 13 ref.

Descriptors: Pollution source, *Biochemical Oxygen Demand, *Waste water treatment.
Identifiers: *Cotton processing wastes, *Wool processing, Chemical replacement, *Waste water analysis.

The article is in two parts; one dealing with cotton processing and stream pollution, and the other with wool processing and stream pollution. Since all cotton cloth processed by mills must be desired, the desizing process is shown to contribute approximately 70% of the total BOD of a mill. Because BOD is a pollution problem, the replacement of the high BOD process chemicals to reduce pollution is feasible. From the data presented it is clear that high BOD starch must be replaced. When dealing with the wool processing, only the scouring, dyeing, and wash after fulling are of interest, since liquid discharges are produced only in these processes. Any pollution reduction plan for scouring and finishing mills must involve the scouring and wash after fulling wastes, since they produce about 89% of the total plant BOD. In order to obtain a complete picture of the actual BOD sources in the wool effluent, the chemical nature of the discharged compounds must be determined. (Rhone-North Carolina State)

W70-07972

COMMONWEALTH V DOUGHERTY (POLICY BEHIND LICENSING OF PLUMBERS).

For primary bibliographic entry see Field 05G.

W70-08063

NUMERICAL ANALYSIS OF DISTRIBUTION OF FLOW AND THERMAL DIFFUSION CAUSED BY OUTFALL OF COOLING WATER,

Central Research Inst. of Electric Power Industry, Tokyo (Japan).

Akira Wada.

13th Congress of the International Association for Hydraulic Research, 31 Aug - 5 Sept, 1969, Proc. Vol 3, Subject C, p 335-342. 11 fig.

Descriptors: *Thermal diffusion, *Coding water, Numerical analysis, Temperature, Numerical model, Richardson number, *Flow.
Identifiers: *Entrainment.

The problem of flow and thermal diffusion in the sea caused by outfall of warmed cooling water is considered. Theoretical studies and model investigations have been made on the conditions under which entrainment occurs in a two layer flow. Ellison and Turner defined the equations of continuity of mass deficiency A and for entrainment coefficient E. Experimental results show that entrainment occurs for the condition of the interfacial gradient exceeding 0.04. The numerical experiment is conducted for the model of a simple semi infinite sea basin with a two layer system. This

model contains seven nonlinear partial differential equations. Attention is confined to the time-dependent response of a two-layer sea. The result shows that the decrease of the temperature of discharged warm water is not only due to the entrainment from lower layer, the horizontal mixing with the surrounding water and the heat emission to the atmosphere, but also due to the entrainment of surface water along the coastal line into the main flow. (Upadhyaya-Vanderbilt)

W70-08131

SYMPOSIUM ON WASTE-DISPOSAL

PROBLEMS OF SOUTHERN MILLS,
American Association of Textile Chemists and Colorists, Durham, N.C.

R. Hobart Souther.
American Dyestuff Reporter, Vol 44, No 12, p 379-400, 1955. 9 ref, 3 fig, 22 tab.

Descriptors: *Biological treatment, Waste water treatment, Waste water disposal.

Identifiers: *Slashing, *Sizing, *Bleaching wastes, *Dyehouse wastes, *Recovery (Waste), *Caustic soda, Textile mill wastes, Bleaching.

The papers, deal with problems of stream pollution from textile processing. Two types of research are required in solving waste-disposal problems: (1) local research and (2) research that is applicable generally. Five of the eleven papers described specific pollution control techniques: cotton slashing with synthetic compounds, bleaching and dyehouse waste studies; textile waste treatment in Texas; biological treatment of highly alkaline wastes; pollution control by recovery of caustic soda. The other six papers deal with stream classification, national waste studies, and federal pollution laws. (Sheffield-North Carolina State Univ)

W70-08141

5C. Effects of Pollution

STRATIFICATION OF FLOW FROM CHANNEL INTO DEEP LAKE,

Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.

For primary bibliographic entry see Field 02H.
W70-07661

SUBSTRATE UTILIZATION IN HETEROGENOUS COMMUNITIES,

Harvard Univ., Cambridge, Mass.

For primary bibliographic entry see Field 05D.
W70-07808

EFFICACY OF METHYL PENTYNOL AS AN ANESTHETIC ON FOUR SALMONIDS,

Bureau of Sport Fisheries and Wildlife, LaCrosse, Wis. Fish Control Lab.

Robert M. Howland, and Richard A. Schoettger.
Investigations in Fish Control, No 29, 1969. 10 p, 1 fig, 5 tab, 19 ref.

Descriptors: *Fish physiology, Rainbow trout, Brown trout, Brook trout, Lake trout, Water temperature, *Fish behavior, Fish management, *Evaluation, Laboratory tests, Equilibrium.

Identifiers: *Anesthetic, *Methylpentynol, *MS-222, Narcosis, Drug.

Effective concentrations of methylpentynol for anesthetizing rainbow trout, brown trout, brook trout, and lake trout, were determined by a series of tests. Concentrations of 1.5 to 8 parts per thousand induced anesthesia. Changes in pH or in water hardness had no significant effect on the rate of anesthesia. Repeated anesthesia had little effect on rate of response. The efficacy of anesthetic solutions was reduced by continuous use. Approximately 1 kilogram of rainbow trout could be effectively narcotized per milliliter of drug. Methylpentynol was compared with MS-222 as a fish anesthetic. Fifty - times as much methylpentynol

was necessary to yield the equivalent effect of 1000 parts per million of MS-222. (See also W70-07840 and W70-07841). (Sjolseth-Washington)
W70-07839

TOXICITY OF METHYL PENTYNOL TO SELECTED FISHES,

Bureau of Sport Fisheries and Wildlife, La Crosse, Wis. Fish Control Lab.

Leif L. Marking.

Investigations in Fish Control, No 30, 1969. 6 p, 55 tab, 16 ref.

Descriptors: *Bioassay, *Toxicity, *Mortality, *Fishkill, Rainbow trout, Brown trout, Brook trout, Lake trout, Pikes, Channel catfish, Bass, Walleye, *Resistance, *Lethal limit, Water temperature, Fish physiology, Fish management.

Identifiers: *Methylpentynol, Drug, *Anesthetic, Bluegills.

Methylpentynol was tested in 96-hour bioassays for its toxicity to rainbow trout, brown trout, brook trout, lake trout, northern pike, channel catfish, bluegills, largemouth bass, and walleyes. The LC50's range from 660 to 1,890 parts per million at 12 deg C. Channel catfish are the most resistant and lake trout are the most sensitive. Two-inch rainbow trout, brown trout, and lake trout are more sensitive to methylpentynol than larger ones in 96-hour exposures. The drug is more toxic to bluegills at 17 deg than at 12 deg C. Toxicity was not influenced in different water hardesses of 10 to 180 parts per million. (See also W70-07839 and W70-07841). (Sjolseth-Washington)
W70-07840

ANNOTATED BIBLIOGRAPHY ON METHYL PENTYNOL,

Bureau of Sport Fisheries and Wildlife, La Crosse, Wis. Fish Control Lab.

Gerald E. Svendsen.

Investigations in Fish Control, No 31, 1969. 5 p, 26 ref.

Descriptors: *Bibliographies, *Reviews, *Fish physiology, *Analytical techniques, Fish behavior, Fish management.

Identifiers: *Methylpentynol, Anesthetic, *Annotated bibliography.

Experiments with methylpentynol as an anesthetic for four salmonids to describe its toxicity and efficacy began in 1964 at the Fish Control Laboratory, La Crosse, Wis. The U.S. Food and Drug Administration requires these data for clearance and labeling of drugs. During the study, a number of selected references on fishery uses of the drug, and on its biochemistry, physiology, and methods of analysis were annotated. (See also W70-07839 and W70-07840). (Sjolseth-Washington)
W70-07841

ENHANCEMENT BY GLYCEROL OF PHOTOTROPHIC GROWTH OF MARINE PLANKTONIC ALGAE AND ITS SIGNIFICANCE TO THE ECOLOGY OF GLYCEROL POLLUTION,

Fisheries Research Board of Canada, Vancouver (British Columbia). Vancouver Lab.

Joseph Y. Cheng, and Naval J. Antia.

Journal of the Fisheries Research Board of Canada, Vol 27, p 335-346, 1970. 11 fig, 2 tab, 16 ref.

Descriptors: Organic wastes, Water pollution effects, *Algae, Phytoplankton, Diatoms, Chrysophyta, Chlorophyta, *Growth rates, Inhibition, *Plant physiology, *Plant growth, Plant growth substances, Plant morphology.

Identifiers: *Glycerol, *Phototrophic growth, *Marine phytoplankton (*Prymnesium parvum*) (*Chroomonas salina*), Glycerol pollution.

The effects of low (0.05 M) and high (0.5-1.0 M) concentrations of glycerol on the growth of 18 species of marine phytoplankters were studied. The

Effects of Pollution—Group 5C

algae were grown in axenic culture in sea water enriched with nitrate, orthophosphate, silicate, trace-metal ions, vitamin B12, thiamine, biotin, and buffered at pH 7.6-7.8. Apart from a chrysomonad (*Prymnesium parvum*) and a cryptomonad (*Chroomonas salina*), none of the species showed any significant growth on glycerol in the absence of light. However, in the presence of light, glycerol enhanced the growth of 16 species, in particular members of the Chrysophyceae and Cryptophyceae, one diatom (*Phaeodactylum tricornutum*), one rhodophyte (*Porphyridium cruentum*), and one chlorophyte (*Nannochloris oculata*). The enhancement effect was observed in the growth rate and in the peak population density, which in many instances was several times that from nonglycerinated cultures and suggested photoheterotrophic growth. Some species showed obvious cytological and metabolic changes from growth on glycerol. (Sjolseth-Washington) W70-07842

THE BIOLOGICAL RECOVERY OF THE CLINCH RIVER FOLLOWING A FLY ASH POND SPILL,
Virginia Polytechnic Inst., Blacksburg. Dept. of Biology.

John Cairns, Jr.

Proceedings Industrial Waste Conference, 25th, held May 5-7, 1970 at Purdue University, Typescript 22 p, 8 fig, 1 tab, 5 ref.

Descriptors: Biological communities, *Water pollution effects, *Fly ash, Hydrogen ion concentration, *Fishkill, Dissolved oxygen, Impaired water quality, Benthic fauna, Water pollution sources, Mayflies, Mollusks, *Community development, On-site investigations, *Fish food organisms, Diversification, Midges, Aquatic insects, Food webs, Stoneflies.

Identifiers: *Biological recovery, *Clinch River, *Community structure analyses.

In June, 1967, highly caustic water from a fly ash settling lagoon spilled into the Clinch River killing over 200,000 fish in 90 miles of river in Virginia and Tennessee. During the summer and fall of 1969, a bottom fauna and fish survey was conducted to determine the extent of biological recovery. Two years after the spill, the Clinch River had not fully recovered. Bottom fauna communities had the same number of organisms; however, their densities were down from the upstream control stations. The authors felt that since fish food organisms such as mayflies and stoneflies were present at all the 'spill areas' a productive sport fishery could be supported. (Sjolseth-Washington) W70-07843

EFFECTS OF METAL POISONING ON FIVE LIVER ENZYMES IN THE KILLIFISH (*FUNDULUS HETEROCLOTTUS*),
National Marine Water Quality Lab., Kingston, R.I. Eugene Jackim, Janice M. Hamlin, and Stephen Sonis.

Journal of the Fisheries Research Board of Canada, Vol 27, p 383-390, 1970. 1 fig, 2 tab, 13 ref.

Descriptors: Water pollution effects, Bioassay, Fishkill, Mortality, *Fish physiology, *Enzymes, Killifishes, *Heavy metals, *Copper, *Inhibition, Inhibitors.

Identifiers: *Liver enzymes, Acid phosphatase, Alkaline phosphatase, Catalase, Xanthine, Oxidase, Ribonuclease, *Metal poisoning, Lead, Mercury, Beryllium, Cadmium, Silver.

Activities of five liver enzymes (acid and alkaline phosphatase, catalase, xanthine oxidase, and ribonuclease) from *Fundulus heteroclitus* surviving exposure to 96-hr TL_m concentrations of salts of six metals (lead, copper, mercury, beryllium, cadmium, and silver) differed markedly from those of unexposed fish. Changes in enzyme activity produced by the exposures were not necessarily the same in magnitude or direction as those observed when the salts were introduced directly into the en-

zyme preparations. It is proposed that changes in liver enzyme activity may be useful as a kind of biochemical autopsy tool for diagnosing sublethal metal poisoning in fish. (Sjolseth-Washington) W70-07844

RESIDUES IN FISH, WILDLIFE, AND ESTUARIES - ORGANOCHLORINE PESTICIDES IN FUR SEALS,
Bureau of Commercial Fisheries, Seattle, Wash. Biological Lab.

Raymond E. Anas, and Alfred J. Wilson, Jr. Pesticides Monitoring Journal, Vol 3, No 4, p 198-200, March 1970. 1 tab, 4 ref.

Descriptors: *DDT, *Chlorinated hydrocarbon pesticides, *Dieldrin, *Pesticide residues, Gas chromatography, Alaska, Washington.

Identifiers: *Polychlorinated biphenyls, *Fur seals, *Callorhinus ursinus, *DDE, DDD, Pribilof Islands, Alaska, Brain tissue.

Samples of liver and brain tissue from 30 northern fur seals (*Callorhinus ursinus*) and 7 fur seal fetuses that were collected on the Pribilof Islands, Alaska, in 1968 and off the Washington coast in 1969, were analyzed for organochlorine pesticides. These compounds were found in all of the fur seals and in three of the fetuses. Polychlorinated biphenyls (PCB) were not detected. Of 30 samples of liver tissue from the seals, all contained DDE; 21, DDD; 24, DDT; and 3 contained dieldrin. Of the 30 brain samples, all contained DDE; 5, DDD; 4, DDT; and none contained dieldrin. DDE was present in liver tissue from three of the fetuses and in brain tissue from two. (Sjolseth-Washington) W70-07845

EFFECTS OF NITRATE OF CULTURE WATER ON THE GROWTH OF THE JAPANESE PEARL OYSTER (IN JAPANESE),

National Pearl Research Lab., Ago (Japan). Yukimasa Kuwatanai, Tamotsu Nishii, and Fumio Isogae.

English summary. Bulletin of the National Pearl Research Laboratory, Vol 4, p 1735-47, 1969. 11 fig, 3 tab, 15 ref.

Descriptors: *Nitrates, Oysters, Cultural control, *Growth rates, *Water quality, Water quality control, Mortality, *Nitrites, Phosphates, Hydrogen ion concentration, Ammonia, Calcium.

Identifiers: Japanese pearl oyster, *Pinctada fucata, *Culture water.

Thirty, one-year-old pearl oysters were divided into six groups of 5 animals each and reared in recirculating tanks for 52 days. Nitrate content of the rearing water was kept at various levels in the five tanks by adding necessary amounts of sodium nitrate to the water. Average nitrate contents in the control tank and the 5 experimental tanks were 11, 588, 1116, 2478, 5151 and 10540 /ug-at N/1, respectively. As the amount of nitrate added increased, the nitrite content of rearing water increased and the phosphate content decreased. Chemical factors other than nitrite and phosphate showed no marked differences among the tanks. The growth of the oysters during the experimental period in the six tanks in order of increasing nitrate content was 432,416, 496, 428, 316 and 370 mg per oyster in cumulative increase of under-water weight. The authors concluded that nitrate less than 10000 /ug-at N/1 in rearing water has no harmful influences on the growth of oysters under the conditions that pH of seawater is over 8.05 (average, 8.09) and alkalinity is over 1.96 (average, 2.10) mN. (Sjolseth-Washington) W70-07846

THE RESPONSE OF FRESH-WATER PROTOZOAN COMMUNITIES TO HEATED WASTE WATERS,
Virginia Polytechnic Inst., Blacksburg. Dept. of Biology.

John Cairns, Jr.

Chesapeake Science, Vol 10, No 3 and 4, p 177-185, 1969. 12 ref, 8 fig.

Descriptors: *Water pollution effects, Water pollution sources, *Thermal pollution, Thermal powerplants, *Thermal stress, Thermal water, *Protozoa, Algae, Diatoms, Animal behavior, *Thermodynamic behavior.

Identifiers: *Temperature shock, *Protozoan communities, Potomac River, Savannah River, Shock effects.

The response of fresh-water protozoan communities exposed to both severe acute temperature shocks as well as small gradual long-term increases are discussed. The former experiments were carried out in plastic troughs with a constant flow of unfiltered lake water. Severe acute shocks (some to nearly 50°C) resulted in a marked reduction in number of species present. However, recovery was quite rapid (a matter of a few days) once the temperature stress ceased. Observations of the effects of small gradual long-term increases were made on the protozoan communities of the Savannah and Potomac rivers each of which received heated waste water discharges. Each of these studies covered a period in excess of nine years and observations are still being made. There was no evidence that indicated the protozoan communities of these rivers had been degraded by the small gradual temperature increases resulting from the discharge of heated waste waters. However, there is evidence that competitive exclusion of algal species by other more tolerant algal species may cause qualitative shifts in the community structure which may be undesirable. (Sjolseth-Washington) W70-07847

BIOASSAY OF KING SALMON EGGS AND SAC FRY IN COPPER SOLUTIONS,
California State Dept. of Fish and Game, Sacramento. Water Projects Branch.

Charles R. Hazel, and Stephen J. Meith. California Fish and Game, Vol 56, No 2, p 121-124, 1970. 3 tab, 4 ref.

Descriptors: *Bioassay, *Copper, Copper sulfate, Heavy metals, Chinook salmon, Fish eggs, Fry, Effects, *Toxicity, Mortality, Growth rates, Inhibition, Water pollution effects, Lethal limit.

Identifiers: *Hatching success.

Flowing water bioassay of chinook salmon (*Oncorhynchus tshawytscha*) eggs and fry in a copper solution indicated that eggs are more resistant to the toxic effects of copper than fry. Copper concentrations of 0.08 mg/liter did not noticeably affect the hatching success of eyed eggs, but concentrations as great as 0.04 mg/liter were acutely toxic to fry and concentrations of 0.02 mg/liter caused increased mortality and inhibited growth. (Sjolseth-Washington) W70-07848

EFFECTS ON THE GROWTH OF JAPANESE PEARL OYSTER OF THE VARIOUS ALKALINE REAGENTS ADDED TO THE CULTURE WATER FOR THE CONTROL OF ITS pH (IN JAPANESE),

National Pearl Research Lab., Ago (Japan).

Yukimasa Kuwatanai, and Tamotsu Nishii.

English summary. Bulletin of the National Pearl Research Laboratory, Vol 13, p 1597-1616, July 1968. 19 ref, 16 fig, 4 tab, append.

Descriptors: Oysters, Alkaline water, Alkalinity, Alkali metals, *Growth rates, *Hydrogen ion concentration, Cultural control, *Water quality, Water quality control, Carbon dioxide, *Sodium, *Sodium compounds, *Calcium hydroxide, Bicarbonates, Ammonia, Nitrates, Nitrates.

Identifiers: Japanese Pearl Oyster, *Pinctada fucata, *Culture water, *Barbital sodium, *Sodium borate, *Sodium carbonate, *Sodium hydroxide, *Tris-buffer, Carbonate ions.

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C—Effects of Pollution

Thirty five one-year-old pearl oysters were equally divided into 7 groups, which were reared in separate recirculating tanks containing various alkaline reagents (6 were tested) for 56 days. The pH was maintained above 8.0. Tris-buffer or barbital sodium required by far the greatest amount to maintain the pH value of culture water above 8.0, and they were followed by sodium borate, sodium hydroxide, calcium hydroxide and then sodium carbonate. The partial pressure of carbon dioxide was the highest in the culture water added barbital sodium or Tris-buffer, and the second highest in that added sodium borate, while the remaining reagents gave as low values as control. The Tris-buffer-added culture water exhibited a remarkably high level for ammonia, nitrite and nitrate as compared with the case of the other alkaline reagents. From the cumulative growth patterns of pearl oysters reared it was possible to class the seven differently treated groups of oyster as follows: (a) Sodium borate and barbital sodium oyster groups showed the most rapid growth. (b) Calcium hydroxide and sodium carbonate oyster groups showed a slow continuous growth. (c) Sodium hydroxide and Tris-buffer oyster groups showed a decline in weight. (d) Control oyster groups showed a negative growth in weight. Authors concluded that the artificial control of pH of the culture water by alkaline reagents created a favorable condition for the growth of pearl oysters. The reagents which brought about the most rapid growth possessed a considerably low dissociation degree. (Sjolseth-Washington)

W70-07849

RELATION BETWEEN ENVIRONMENTAL CHARACTERISTICS OF WATERS AND CHANGES OF PHYTOPLANKTON IN AN ESTUARY WHERE RED TIDE OFTEN APPEARS (IN JAPANESE), Mie Prefectural Univ., Tsu (Japan).

Fukuzo Uyeno.

English summary. Bulletin of the Plankton Society of Japan, Vol 16, No 2, p 89-98, 1969. 1 tab, 6 fig, 22 ref.

Descriptors: Environmental effects, Phytoplankton, *Red Tide, Dinoflagellates, Bottom sediments, Essential nutrients, Nutrient requirements, Estuarine environment, Dissolved oxygen.

Identifiers: Skeletonema costatum, *Environmental conditions, Ago Bay, Japan.

The relationship between environmental conditions, especially about the depletion of dissolved oxygen near the bottom, and the occurrence of nanoplankton in an area where red tides often occur was observed in Ago Bay, from 1966 till '68. Land-drainages and upwelled waters from the bottom layers supplied inorganic nutrient salts for phytoplankton bloom. This produced a rapid increase of chlorophyll-a at the surface and in the mid-layer. The former mainly consists of Skeletonema costatum and the latter of flagellates including dinoflagellates. Author concluded that the superficial bottom mud is a source of both inorganic nutrients and trace growth acceleration substances. This analysis of the mechanism of supply of such substances to the water in relation to seasonal changes of environmental conditions and species occurrence will be required for future study. (Sjolseth-Washington)

W70-07850

STUDIES ON THE EFFECTS OF SEVERAL AGRICULTURAL CONTROL CHEMICALS ON THE SPAWNING OF WILD GOLD FISH (CARASSIUS CARASSIUS CUVIERI T. ET S.) AND THE HATCHING OF THE EGGS (IN JAPANESE), Freshwater Fisheries Research Lab., Tokyo (Japan).

Sekio Kimura, and Masahiro Matsushima.

English synopsis. Bulletin of Freshwater Fisheries Research Laboratory, Vol 19, No 2, p 121-135, 1969. 7 tab, 30 ref.

Descriptors: Bioassay, *Mortality, *Dieldrin, *Chlorinated hydrocarbon pesticides, Pesticide toxicity, Fish reproduction, Carp, Water pollution effects, Lethal limit, *Organophosphorus pesticides, *Spawning, Fish eggs, Viability, Hatching, Fish behavior.
Identifiers: *Dipterex, Ethyl parathion, *Lindane, PCP-Na, *MCPCA, Gold fish, Tolerance, Carassius carassius.

The effects of dipterex, ethyl parathion, dieldrin, lindane, PCP-Na, and MCPCA on the spawning of gold fish and the hatching of their eggs were studied. The following conclusions were obtained: The chemicals tested did not affect adult wild gold fish, their spawning ability, or the eggs at the concentrations of 0.1x48 hr TLm for carp fry. Detrimental effects were observed at the concentrations higher than 0.5x48 hr TLm. The authors stress the need to understand the biological effects of chlorinated hydrocarbon and other pesticides which easily accumulate in fish. (Sjolseth-Washington)

W70-07851

SENSITIVITY OF POND FISH TO COTNION (AZINPHOSMETHYL) AND PARATHION, Hebrew Univ., Jerusalem (Israel). Dept. of Microbiological Chemistry.

M. Lahav, and S. Sarig.

Bamidgeh, Bulletin for Fish Culture in Israel, Vol 21, No 3, p 67-74. 4 tab, 9 ref.

Descriptors: Organophosphorus pesticides, Carp, Mullets, *Pesticide toxicity, *Bioassay, Mortality, Toxicity, Resistance, *Lethal limit, Fishkill.
Identifiers: *Cotnion, *Azinphosmethyl, *Parathion, Tilapia, Median tolerance limit.

In recent years there have been a large number of poisonings of pond fish killing by pesticides applied to field crops adjoining the ponds. In order to limit damage due to this cause, it was necessary to determine the lethal dosages of these pesticides for the various pond fish species, as well as the permissible concentrations which do not cause damage under the given conditions. (Sjolseth-Washington)

W70-07852

EFFECTS OF NITROGEN LIMITATION ON THE GROWTH AND COMPOSITION OF UNICELLULAR ALGAE IN CONTINUOUS CULTURE,

School of Aerospace Medicine, Brooks AFB, Tex.
For primary bibliographic entry see Field 05D.

W70-07957

WASTE WATER TREATMENT IN MODERN TEXTILE OPERATIONS (IN GERMAN),

For primary bibliographic entry see Field 05D.

W70-07977

SOME LONG-TERM TRENDS IN WATER QUALITY OF RIVERS AND LAKES, Illinois State Water Survey, Urbana.

William C. Ackermann, Robert H. Harmeson, and Robert A. Sinclair.

Transactions, American Geophysical Union, Vol. 51, No. 6, p 516-522, June 1970. 6 fig.

Descriptors: *Water quality, *Standards, *Pollution abatement, Sulfates, Alkalinity, Chlorides, Dissolved solids, Nitrates, Lake Michigan, Mississippi River, Ohio River.
Identifiers: *Metropolitan areas, Illinois River.

Long term trends of water quality have been examined on reasonably continuous measurements of conservative water quality elements on four areas of significant size. Of particular interest were large areas that reflected major population and technological consequences, and locations where the water quality, in turn, was of importance to a large number of present and future users. The four areas studied were: the southwest shore of Lake

Michigan; the Mississippi River at Alton, Illinois; the Illinois River at Peoria, Illinois, and the Ohio River at Cairo, Illinois. Five parameters of water quality were examined: chlorides, sulfates, nitrates, total dissolved solids, and alkalinity. It was concluded that in recent years accelerated pollution abatement efforts for the parameters and areas studied do not appear to have reversed the trend of increasing waste burdens, much less returned us to the levels of seventy or more years ago. One's degree of concern about this depends upon criteria or benchmarks; but one statement can be made with some confidence: we have not yet overcompensated. (Davis-Chicago)

W70-07983

ULTRASONIC EMULSIFICATION OF OIL TANKER CARGO, FEASIBILITY STUDY USING AN ULTRASONIC PROCESS TO EMULSIFY PETROLEUM TO REDUCE OIL SLICK HAZARDS IN EVENT OF SPILLAGE AT SEA.

Sonic International, Inc., Dallas, Tex.

For primary bibliographic entry see Field 05G.

W70-07996

EFFECTS OF INSECTICIDES ON ALGAE, Ontario Water Resources Commission, Toronto. Div. of Research.

A. E. Christie.

Water and Sewage Works, Vol 116, p 172-176, 1969. 6 tab, 31 ref.

Descriptors: *Algae, *Insecticides, Toxicity, Degradation (Decomposition), DDT, Alkalinity, Stabilization, Waste storage, Ponds, Hydrolysis, Metabolism, Chemical reactions, Chlorella, Tracers, Radioactivity, Carbon radioisotopes, Hydrogen ion concentration, Scenedesmus, Euglena, Bacteria, Yeasts, Actinomycetes, Ponding, Waste treatment.
Identifiers: Sevin, Malathion, Chlorella pyrenoidosa, Schroderia, Thimet, Trichoderma.

DDT, Sevin, and Malathion were studied to determine their effect on algal populations associated with waste stabilization ponds and their possible degradation in an algal environment. The pesticides vary in degree of toxicity to algae and in extent to which they are degraded in presence of algae. DDT exhibited no toxic properties up to concentrations of 100 milligrams/liter and received only slight degradation. Sevin is toxic at concentrations above 0.1 milligrams/liter and is not altered appreciably in acidic media. Malathion appears to receive extensive conversion and, although capable of altering composition of a mixed algal community, did not display persistent inhibitory effect. Extending this to the alkaline waste stabilization pond and its algal community, entry of DDT, up to 100 milligrams/liter, is not likely to be toxic nor will the material be degraded by algae. A similar quantity of Sevin would seriously reduce efficiency of the pond with conversion more likely to occur by alkaline hydrolysis than algal metabolic processes. An equivalent slug of Malathion, although temporarily interrupting operation of the pond, could be broken down rapidly by chemical and metabolic reactions. (Jones-Wisconsin)

W70-08097

INSECTICIDE RESIDUES IN SOME COMPONENTS OF THE ST LAWRENCE RIVER ECOSYSTEM FOLLOWING APPLICATIONS OF DDD,

Department of Agriculture, Saskatoon (Saskatchewan); and Saint Dunstan's Univ., Charlottetown (Prince Edward Island). Dept. of Chemistry.

F. J. H. Fredeen, and J. Regis Duffy.

Pesticides Monitoring Journal, Vol 3, No 4, p 219-226, 1970. 4 tab, 14 ref.

Descriptors: *Insecticides, *St Lawrence River, Water pollution sources, Water pollution effects, Mud, Mollusks, Fish, Insects, DDT, Silts, Suckers, Catfishes, Bass, Perches, Pikes, Sampling, Snails,

WATER QUALITY MANAGEMENT AND PROTECTION—Field 05

Effects of Pollution—Group 5C

Algae, Diatoms, Clams, Shellfish, Amphipoda, Water birds, Wisconsin, Analytical techniques. Identifiers: *Residues, *DDD, DDE, TDE, Blackfly larvae, Cladophora, Cyprinus carpio, Catostomus commersoni, Amelurus nebulosus, Perca flavescens, Ambloplites rupestris, Esox lucius, Campeloma, Psidium, Shadfly, Chironomids, Clear Lake (Calif), Richelieu River (Quebec), Green Bay (Wis), Mackerel, Montreal (Canada).

DDD (TDE) residues were measured in water, mud, mollusks, and fish of the St Lawrence River in 1967 during and after applications of DDD to control nuisance insects. Concentrations detected in water (up to 0.0139 ppm) ranged from 1 to 17% of those applied to the river 10 miles upstream. DDD concentrations in mollusks 17 miles upstream from the point of application and 10 and 45 miles downstream, averaged 0.002, 0.101, and 0.0 ppm, respectively. In the same samples, concentrations of DDT and DDE combined (from unknown sources) averaged 0.030, 0.225, and 0.027 ppm. In edible flesh from 216 fish of 5 species, DDD residues averaged 0.156 ppm in samples collected 17 miles upstream and 0.369 in the combined samples from points 10 and 45 miles downstream. Residues of DDT plus DDE in these same samples averaged 0.224 and 0.227 ppm, respectively. The highest concentration of DDD in an individual fish was 1.81 ppm. The ultimate fate of the DDD, that is its conversion to materials with reduced toxicities, is poorly understood. DDD is itself a product of the reductive dechlorination of DDT in nature. (Jones-Wisconsin)
W70-08098

A QUANTITATIVE METHOD FOR ASSESSING THE TOXIC EFFECTS OF SOME WATER SOLUBLE SUBSTANCES, BASED ON CHANGES IN PERIPHYTON COMMUNITY STRUCTURE, Ottawa Univ. (Ontario). Dept. of Biology. Mike Dickman. Water Research, Vol 3, p 963-972, 1969. 4 fig, 1 tab, 11 ref.

Descriptors: *Data collections, *Toxicity, *Periphyton, *Water pollution effects, *Water pollution, Water chemistry, Biological communities, Lakes, Streams, Diatoms, Silica, Chlamydomonas, Chlorella, Chlorophyta, Sampling, Resins, Effluents, Methodology, Monitoring, Water quality, Water pollution sources, Water analysis, Analytical techniques. Identifiers: *Soluble substances, Germanium dioxide, Diversity index, Lago Banolas (Spain).

A method to assess the potential damage of a particular water soluble compound released in lakes and streams is described. The results of a test, using germanium dioxide which has a known effect, provided evidence that quantitative changes in the species composition of the colonizing periphyton community reflect the nature of the toxicant to which they were exposed. Natural diatom growth in the presence of germanium was inhibited and the ensuing changes in the species composition of the treated community were reflected in changes in the diversity index. The major disadvantage in applying this technique to general usage is that the concentration of the toxicant at the gel-water interphase is neither controllable nor known under the condition described for this experiment. However, anti-fouling resins are available for which the leaching rates of chemicals with different solubility coefficients and for different current velocities are known. The major advantage of this technique is its wide potential applicability. Wherever a pollutant, such as an insecticide, is suspected, it could be impregnated in a gel and exposed to the periphyton in the same or a similar area as that into which the toxicant would be released. (Jones-Wisconsin)
W70-08101

PESTICIDES IN WATER, Battelle Memorial Inst. Richland, Wash.; and Agricultural Research Service, Prosser, Wash. Crops Research Div.

J. L. Nelson, V. F. Bruns, C. C. Coutant, and B. L. Carlile. Pesticides Monitoring Journal, Vol 3, No 3, p 186-189, 1969. 2 tab, 6 ref.

Descriptors: *Pesticides, *Copper sulfate, *Irrigation canals, Suspended load, Sediments, Bottom sediments, Algicides, Washington, Sampling, Aquatic weeds, Chlorophyta, Rooted aquatic plants, Rainbow trout, Crops, Washington. Identifiers: Sunnyside (Wash), Rhodamine-B.

Chemical and physical behavior was determined of copper sulfate applied as algicide in irrigation canal water. Measurements of copper concentrations in water, in suspended sediment, and in bottom sediment of an irrigation canal after a copper sulfate treatment at 1 pound/cubic feet per second indicate that, after dissolution, much of the copper is sorbed by suspended sediment which gradually settles to the canal bottom. A large part of the copper in the deposited sediment is then slowly fed back into the canal water over a period of many hours. Copper buildup in irrigated soils appears to be minor and the possibilities of harmful effects from the release of such treated water for irrigation or domestic purposes are remote. Copper accumulation in the irrigated soil is far below levels toxic to crop plants. Similar treatments have been commonly used for decades as algae control; as far as known, harmful effects from such usage in irrigation canals have never occurred or been reported. The fish studied apparently survived because peak concentrations were of short duration and because dead algae did not accumulate to clog gills. (Jones-Wisconsin)
W70-08102

THE NEWEST DEVELOPMENT IN LAKE LUZERNE (IN GERMAN), Eidgenoessische Technische Hochschule, Zurich (Switzerland). For primary bibliographic entry see Field 02H.
W70-08106

THE ADAPTATION OF PLANKTON ALGAE. V. VARIATION IN THE PHOTOSYNTHETIC CHARACTERISTICS OF SKELETONEMA COSTATUM CELLS GROWN AT LOW LIGHT INTENSITY, Royal Danish School of Pharmacy, Copenhagen. Dept. of Botany. For primary bibliographic entry see Field 02K.
W70-08110

THE INHIBITORY EFFECTS OF COPPER ON MARINE PHYTOPLANKTON, Dow Chemical Co., Freeport, Tex. Texas Div. E. F. Mandelli. Marine Science, Vol 14, p 47-57, 1969. 6 fig, 1 tab, 21 ref.

Descriptors: *Marine water, *Copper, *Algae, Sea water, Temperature, Salinity, Bioassay, Analytical techniques, Lethal limits, Dinoflagellates, Diatoms. Identifiers: *Copper chloride, Uptake, Freundlich isotherm, Blue-green algae, Green algae.

The growth of several species of dinoflagellates and diatoms in batch cultures under continuous illumination was inhibited at 20°C by concentration of copper between 0.055 and 0.265 microgram/milliliter. *Cocochloris elabans* failed to grow at 0.03 microgram/milliliter and 40°C, whereas *Dunaliella tertiolecta* survived 0.6 microgram/milliliter at 30°C. *Skeletonema costatum* in light-dark cultures with maintenance of constant number of cells and copper ions was inhibited at 0.05 microgram/milliliter. A positive correlation was found between the log of copper uptake: biomass of algae ratio and the temperature, and a negative correlation between the same ratio and salinity. (Wilde-Wisconsin)
W70-08111

A SIMPLE METHOD OF ASSESSING THE ANNUAL PRODUCTION OF STREAM BENTHOS, Waterloo Univ. (Ontario). Dept. of Biology. For primary bibliographic entry see Field 07B. W70-08113

INVESTIGATIONS OF THE EFFECT OF THE DISTRIBUTION OF SEWAGE EFFLUENT IN LAKES (IN GERMAN), Kantonales Laboratorium, Zurich (Switzerland). E. A. Thomas.

English summary. Verhandlungen der Internationalen Vereinigung für Theoretische und Angewandte Limnologie, Vol 17, p 517-528, 1969. 4 fig, 3 tab, 9 ref.

Descriptors: *Water pollution effects, *Lakes, *Sewage effluents, *Sewage, Industrial wastes, Chemical analysis, Analysis, Coliforms, Bacteria, Phenols, Potable water, Chlorination, Phosphates, Hydrogen ion concentration. Identifiers: *Chlorophenols, Bacteriological analysis, Iron chloride, Lake Zurich, Lake Pfäffikon.

The distribution path of purified sewage effluent in Lake Pfäffikon was traced by chemical and bacteriological analyses. The sewage travelled intact from the shore down the slope to a depth of 5 meters and then spread out horizontally. The industrial effluent, contaminated with phenol, entered Lake Zurich at a depth of 31 meters and was diverted by the current over a distance of 2200 meters to the intake of drinking water. The chlorination of water gave rise to chlorophenols thereby rendering water unpalatable to 80,000 people for a period of 1 to 2 days. (Wilde-Wisconsin)
W70-08115

THE THERMAL LOADING-NEW THREAT TO AQUATIC LIFE, Maryland Univ., College Park. Dept. of Environmental Research. Joseph A. Mihursky. Catalyst, Vol. 2, No. 3, p 6-9, (1969). 2 fig.

Descriptors: *Thermal pollution, *Aquatic life, *Cooling water, Powerplants, Metal pipes, Cooling towers, Nuclear energy, Chlorine, Seasonal, Oysters, Salmon, Trout, Clams, Striped bass, Shellfish, Water pollution effects. Identifiers: Chesapeake Bay.

The problem of thermal pollution and its effect on aquatic life are examined. The excess temperatures associated with thermal pollution may cause as much as 100 per cent mortality among aquatic animals. This increase in temperature is usually caused by man's increased production of electricity. The fossil fuel powerplants of the past, however, produced less thermal pollution than our newer nuclear powerplants. These newer plants demand more cooling water than is available in the streams where water is already being used for cooling. A problem that often arises is corrosion of metal tubes. An example of the results of this corrosion is the green oyster caused by a high copper concentration in the water. There are basically three alternatives to the problem. They are: (1) ignore the problem; (2) produce electricity in a different manner; or (3) find ways to redirect waste heat. At present, two new engineering designs to help correct the problem are the evaporative cooling towers and a closed circuit cooling system similar to an automobile radiator. The author proposes further research on eleven area recommendations. (Osborne-Vanderbilt)
W70-08119

THE THERMAL EFFECTS: A REPORT ON UTILITY ACTION, F. C. Olds. Power Engineering, Vol 74, No 4, p 26-31, April 1970. 2 fig, 4 tab.

Descriptors: *Utilities, *Thermal pollution, *Surveys, Cost-benefit analysis, Cooling towers, Ponds,

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C—Effects of Pollution

Water temperature, Power system operations, Design criteria, Standards, Heat flow, Water pollution effects.

Identifiers: Mixing zone.

The results of a thermal discharge survey conducted by Power Engineering are described. The survey includes 43% of all utilities in the U.S. with 8-Mw or more of steam-electric generating capacity. Data dealing with percent of return and type of utility is listed in tabular form. The results indicated that 123 utilities of the 135 utilities reporting may not be in compliance with existing standards. Moreover, companies with higher capacities are not in compliance as much as those with lower capacities. Further, the survey showed a tendency for utilities to change from direct discharge to cooling towers for their next plants. Twenty companies estimate that they will spend 157 million dollars on new plants to ensure that they meet new water temperature standards. From this analysis, four major aspects of temperature compliance stand out clearly. They include: (1) temperature standards are a moving target; (2) mixing zones are undefined; (3) upper temperature limits are rigidly and capriciously set; and (4) as standards become more stringent, costs skyrocket. (Osborne-Vanderbilt)

W70-08122

FIELD SITES AND SURVEY METHODS,
Johns Hopkins Univ., Baltimore, Md. Dept. of Environmental Engineering Science.

John C. Geyer, John E. Edinger, Willard L. Graves, Jr., and Derek K. Brady.

Cooling Water Studies for Edison Electric Institute, Report No 3, June 1968. 42 fig, 43 tab, 4 ref. EEI Research Project RP-49.

Descriptors: *Thermal pollution, *Meteorology, *Instrumentation, *Data collection, Heat exchangers, Thermal stratifications, Hydrographs, Powerplants, Water pollution effects.

Identifiers: *Data reduction, *Heat dissipation, Parameters, Receiving waters, Thermographs, Pyrhieliometer, Dispersion coefficient.

The main features of eleven field sights are summarized and described including the survey data collection techniques used to investigate the dissipation of heat from the different types of natural waters which received the heated discharges from the eleven thermoelectric generating plants. A history of the development of this study is followed by a tabulation of the geographical and hydrological features of each study site, complete with details of types of survey instruments, survey procedures and data reduction techniques. The eleven study sites were compared first in terms of their geographic location and climate, then by groups according to type of receiving waterbody, and also in terms of their various heat dissipation characteristics. Comparisons were made between the various survey procedures adopted at each site, and between the different types of meteorological instruments used. The methods of data reduction employed at the field sites are summarized, and an outline is given of the data processing required prior to storage and retrieval for interpretation and analysis. The analytical objectives of the study are also summarized in relation to the applicability of the different study sites to these objectives. (Osborne-Vanderbilt)

W70-08123

ENVIRONMENTAL EFFECTS OF NUCLEAR COOLING FACILITIES,
Oregon State Univ., Corvallis. Dept. of Atmospheric Sciences.

William P. Lowry.

American Meteorological Society, Bulletin, Vol 51, No 1, p 23-24, January 1970.

Descriptors: *Fog, *Cooling towers, Temperature, Vapor pressure, Winds, Humidity, Climatology, Atmospheric physics, Water pollution effects, *Environmental effects.

Identifiers: *Cooling ponds, Wet plumes.

The foreseeable but not quantifiable variable, fogging, was discussed. Also, the effects that cooling towers and cooling ponds might have on fogging conditions were considered. The conclusion reached after considering these environmental effects was that under the climatic conditions of western Oregon, a significant fraction of the days of each year fall in the middle of the spectrum of uncertainty, thereby representing a potential or latent fogging problem. Moreover, the scientific and engineering professions do not now have either the information or the experience necessary even to begin operational avoidance or reduction of the fogging problem which we know exists in connection with industrial cooling tower and pond facilities. (Osborne-Vanderbilt)

W70-08125

MOISTURE POLLUTION OF THE ATMOSPHERE BY COOLING TOWERS AND COOLING PONDS,

Oregon State Univ., Corvallis. Dept. of Atmospheric Sciences.

E. W. Hewson.

American Meteorological Society Bulletin, Vol. 51, No. 1, p 21-22, January 1970.

Descriptors: *Atmospheric physics, *Cooling towers, Chemical wastes, Terrain analysis, Precipitation (Atmospheric), Humidity, Wetting, Air temperature, Winds, Cities, Water pollution effects.

Identifiers: *Cooling ponds, *Moisture pollution, Visibility, Icing, Sunshine.

Possible meteorological influences as could be encountered from water vapor releases from cooling towers and cooling ponds are reviewed. Such meteorological aspects as visibility, precipitation, humidity, wetting, icing, sunshine, temperature, and wind are discussed. An additional problem concerning an effluent containing chemical pollutants is considered. This consideration was made for both flat terrains and in valleys. Other terrain modifications to the atmospheric moisture problem were made for the special cases of urban areas and along shorelines. In general, the influence is likely to be local or non-existent. The possibility of greater stability of natural fogs due to heat input is increased. (Osborne-Vanderbilt)

W70-08128

TEMPERATURE TOLERANCE OF EGGS AND YOUNG OF COLUMBIA RIVER CHINOOK SALMON,

Hanford Atomic Products Operation, Richland, Wash.

P. A. Olson, and R. F. Foster.

Transactions of the American Fisheries Society, Vol 85, p 203-207, 1957. 2 fig, 2 tab, 3 ref.

Descriptors: *Chinook salmon, *Salmon, *Fish, Fish eggs, Growth stages, Fish reproduction, Fry, Columbia River, *Thermal pollution, Temperature, Seasonal, Fluctuation, Period of growth, *Water pollution effects.

Identifiers: Priest Rapids Dam.

A study was made on the temperature tolerance of eggs and young of chinook salmon which spawn in the main stem of the Columbia River. The control temperature followed a seasonal trend typical for the locality. It started at 57 deg F, reached a minimum of 36 deg F, and increased to 47 deg F at the end of the test. Other experimental lots averaged about 4 deg F colder and 2 deg F, 4 deg F, and 8 deg F warmer than the control throughout the greater part of the test. Significant mortality above that of the control occurred only in the warmest lot. Although about 90 percent of the eggs in this group hatched successfully, the fry and early fingerlings suffered heavy mortalities even though the mean temperature of this lot was well below 50 deg F during the fingerling stage. The results of this single experiment indicated that the eggs could begin incubation at temperatures as high as 61 deg F without significant loss. (Speakman-Vanderbilt)

W70-08129

NUCLEAR POWER AND THERMAL POLLUTION: ZION, ILLINOIS,
Argonne National Lab., Ill. Radiological Physics Div.

Philip F. Gustafson.

Bulletin of the Atomic Scientists, Vol 26, No 3, p 17-23, March 1970. 5 fig.

Descriptors: *Thermal pollution, Radioactive wastes, *Nuclear wastes, Water law, *Powerplants, Aquatic plants, Lake Michigan, Heat transfer, Seasonal, *Water pollution effects.

Identifiers: Maximum possible concentration.

In the Chicago metropolitan area, the Commonwealth Edison Company is building new nuclear power plants to provide badly needed additional generating capacity. Fear of radioactive discharges and thermal pollution has provoked two lawsuits seeking injunctions to restrain the utility from discharging heated, effluent water and radioactive material from a 2,200,000 kilowatt, two unit nuclear power plant at Zion, Illinois into Lake Michigan. One of the lawsuits has been brought by the Metropolitan Sanitary District of Greater Chicago. It asserts that condenser-heated lake water will "radically raise the temperature of substantial parts of the waters of the lake and cause thermal pollution, severely and deleteriously affecting the ecology of the lake." A second suit contends that three billion gallons of lake water a day would be heated 18 to 20 degrees Fahrenheit above ambient lake temperature. Its discharge back into the lake would increase the toxicity of existing pollutants, stimulate the growth of aquatic plant nuisances and speed up the deterioration of Lake Michigan. The suits cite the threat of radioactive pollutants in the lake, the principal source of domestic water in a region of eight million people. The author concludes that the amount of nuclear power to be installed by 1975 gives no cause for concern about thermal or radioactive pollution. Further work is needed to ascertain effects of continued installation of power plants along Lake Michigan. (Osborne-Vanderbilt)

W70-08130

COOLING RESERVOIR STUDY,

J. D. Calbert.

Power Engineering, Vol 71, No 12, p 52-53, Dec 1967. 1 fig, 1 tab.

Descriptors: *Cooling water, Feasibility studies, *Water temperature, *Computer programs, Model studies, Energy budget, Air temperature, Streamflow, Water rights.

Identifiers: *Square Butte Creek, Cooling reservoir.

Low-cost energy from lignite was to be available in early 1970 from Minnkota's new 121-Mw plant at Center, N.D. In determining the feasibility of this project, Minnkota engineers assessed Square Butte Creek, flowing through the lignite fields, as a potential water supply. The results favored construction of an economic dam and reservoir. The fundamental considerations in the planning and design of the cooling reservoir were assessed by a comprehensive computer program. An energy budget analysis involving a relationship between degrees of cooling required and net heat loss per unit of cooling pond area was used along with a great deal of meteorological and streamflow data. Further, the data was based on the critical conditions along Square Butte Creek during 1960 and 1961. The results showed that the initial 212-Mw steam unit could operate on the proposed reservoir without make-up water beyond natural flow. This paper contains a table of the actual computer readout for the 31 days in July 1961 (the most critical time period) showing what the operating conditions would have been. About 2 acres of water surface per megawatt were required. (Osborne-Vanderbilt)

W70-08132

SD. Waste Treatment Processes**THE INCINERATION OF SOLID AND LIQUID WASTE AT FABENFABRIKEN BAYER,**
Horst W. Fabian.Proceedings of the Industrial Waste Conference,
23rd, 1968, p 874-882. 6 fig.Descriptors: *Incineration, *Industrial wastes,
*Solid wastes, *Liquid wastes, *Costs, *Air pollution,
*Gases, Chlorine, Heat exchangers.

Identifiers: *Chlorine wastes, Afterburners, Rotary kiln.

Of the 500,000 cubic meters of wastes produced annually at the Leverkusen Works of Farbenfabriken Bayer, 40,000 metric tons of solid, pasty, and liquid wastes can be incinerated. An incinerator plant, built in 1967 at a cost of 18 million D-marks disposes of these wastes at a cost of 80-100 D-marks per metric ton. Incineration of most wastes occurs in a rotary kiln 12 meters by 3 meters, with detention times of 30-60 minutes at a temperature of 1200 deg C. Solid wastes are reduced 90% by volume, and 70% by weight. Waste gases (60,000-70,000 Nm³/hr) are sent through a system of afterburners at 1200 deg C and then to a series of heat exchangers before discharge through a 100 meter stack. Up to 25 metric tons of steam are recovered per hour at 400 deg C and 40 kg/sq cm. Wastes with chlorine are burned in another flame tube and the waste gases are treated separately in a water scrubber which has an efficiency of 95% and reduces the waste gas to less than 1000mg/Hm³HCl, the upper limit specified by the authorities. Upon completion of a sewage treatment plant, another 150,000 cubic meters of sludge will be incinerated at this plant each year. (Makela-Texas)

W70-07707

MODEL STUDY OF COLLOID REMOVAL,
Minnesota Univ., Minneapolis.

Walter J. Maier.

Journal of the Water Pollution Control Federation,
Vol 40, No 3, Part 1, p 478-491, March 1968. 8 fig,
2 tab, 16 ref.Descriptors: *Biological treatment, *Colloids, Thin films, *Waste water treatment, Efficiencies, Slime, Activated sludge, Concentration (Composition), Costs, *Enzymes, Trickling filter.
Identifiers: *Starch.

Biological treatment of colloidal starch solutions is described in terms of a sequence of steps any one of which may be rate controlling: (1) mass transfer of substrate from bulk liquid phase to cell or active enzyme site, (2) degradation of colloidal particles into smaller fragments to facilitate passage through the semi-permeable membrane of metabolizing bacteria cells, (3) metabolism of the substrate particles within the cells to provide energy and building blocks for growth. Experimental results of two types of reactors are described using starch as a representative colloid. Results from process variable studies show that mass transfer is the rate controlling factor in a laminar film flow reactor which simulates trickling filter conditions. On the other hand, high rates of mass transfer are obtained in a well mixed reaction vessel simulating activated sludge conditions due to eddy current transport. Hydrolytic degradation of colloid starch into small soluble carbohydrates proceeds rapidly and does not appear to be rate limiting in either type of reaction. Hydrolysis is mediated by enzymes which are available outside the confines of the semi-permeable cell membranes. Enzyme activity was observed in cell-free filtrates thus indicating some presence of free enzymes in solution. It is theorized that it should be possible to improve the efficiency of trickling filters by increasing the mass transfer. This could be accomplished by improved packing design and/or agitation. (Hancuff-Texas)

W70-07708

BIOLOGICAL TREATMENT OF MIXTURES OF TEXTILE WASTES AND DOMESTIC SEWAGE,
Cone Mills Corp., Greensboro, N.C.
R. H. Souther, and T. A. Alspaugh.
Sewage and Industrial Wastes, Vol 28, p 166-176,
1956. 13 tab, 1 fig, 14 ref.

Descriptors: *Sewage, *Trickling filters, Pilot plants, Alkalinity, Sedimentation, Filtration, Activated sludge, Domestic wastes, *Biological treatment, Waste water treatment.

Identifiers: *Textile mill wastes.

Experiments were made on a mixture of sewage and highly alkaline textile mill waste waters to compare the efficiency of three different methods of treatment, these methods being (1) two-stage sedimentation and high-rate biological filtration, (2) single-stage high-rate filtration followed by the activated-sludge process, and (3) a two-stage high-rate filtration followed by the activated sludge process. A mixture of 40% of the waste water and 60% sewage was applied at rates of 125, 150, 210 and 250 gal/day. Filters were 1.25 feet in diameter. The results showed that method 2 gives an effluent suitable for discharge to a small stream, the reduction in BOD varying from 78% at a rate of flow of 125 gal/day to 66% at a rate of 250 gal/day. Except at a rate of flow of 125 gal/day with a recirculation ratio of 2:1, two-stage filtration and final sedimentation alone did not give as satisfactory effluent as method 2. Method 3 gave excellent results, with reductions in BOD varying from 97.4% at a rate of 250 gal/day. It is planned to continue the study. (Work-North Carolina State)

W70-07709

WASTEWATER TREATMENT PLANT DESIGN EXPERIENCE AT VANCOUVER, BRITISH COLUMBIA,Greater Vancouver Sewage and Drainage District
(British Columbia).

D. G. Devlin.

Journal of the Water Pollution Control Federation,
Vol 40, No 3, p 468-477, March 1968. 3 fig, 2 tab.

Descriptors: *Waste water treatment, *Sewage treatment, Design, Digestion, Chlorination, Sludge Operation and Maintenance.

Identifiers: *Primary treatment, Vancouver (British Columbia).

A discussion of problems and solutions is presented for operation of two primary waste water treatment plants in the Vancouver district for the Lion's Gate treatment plant and Iona Island Plant. The Lion's Gate treatment plant consists of prechlorination, communication, preaeration, grit removal, sedimentation, post-chlorination, and sludge digestion with use of digester gas in boilers and engines. The first problem experienced was that of infiltration into the interceptor sewers; the sources are being sought out and eliminated. The practice of discharging septic tank pump trucks directly to the influent had to be discontinued due to the shock loading effects. The solution, direct transfer to the digesters had to be discontinued due to the restrictions on the quantity of digested sludge permitted to be discharged to the Strait of Georgia. Some difficulties experienced in sampling the influent and effluent are presented. Experiences at the Iona Island treatment plant are enumerated much along the same lines. In spite of these problems, the plants are said to have generally functioned well. (Hancuff-Texas)

W70-07710

DESIGN OF THE NEWTOWN CREEK WATER POLLUTION CONTROL PROJECT,

Department of Water Resources, New York. Bureau of Water Pollution Control.

Joseph Cunetta, and Robert Feuer.

Journal of the Water Pollution Control Federation,
Vol 40, No 4, p 643-658, April 1968. 2 fig, 11 tab.

Descriptors: *Waste water treatment, *Design, *Costs, Activated sludge, Sewage treatment, Pollution abatement, Aeration, Digestion, Screens, Sludge, New York.

Identifiers: Newtown Creek (New York), Parameters, Barging.

The intercepting sewer system for the Newtown Creek project serves portions of the burroughs of Manhattan, Brooklyn, and Queens, and collects from a drainage area of 15,389 acres. The Newtown Creek treatment plant utilizes high-rate activated sludge process, and has a design capacity of 310 mgd from an estimated equivalent population of 2,500,000. Included in the report is a description of the area and population served, the waste water treated, methods of conveyance, receiving water ways, plant site, and treatment units used. The dimensions, capacities, areas, loadings, removal capabilities, volumes, operating conditions, detention times and other parameters are tabulated for each unit process. The facility includes grit chambers, aeration tanks, sedimentation tanks, digesters, and the facilities for hypochlorination of plant effluent. The high rate activated sludge process is designed to achieve removals of 70% of the suspended solids and 60% of the BOD, both of which are estimated at 200 mg/l influent. A high-rate digestion is provided for the sludge prior to barging to sea. When completed, the Newtown Creek Water Pollution Control project will have cost approximately \$167,000,000. (Hancuff-Texas)
W70-07711

APPLICATION OF COMPLETELY MIXED ACTIVATED SLUDGE DESIGN EQUATIONS TO INDUSTRIAL WASTES,

Kansas Univ., Lawrence.

Carl E. Burkhead, and Ross E. McKinney.

Journal of the Water Pollution Control Federation,
Vol 40, No 4, p 557-570, April 1968. 13 fig, 7 tab, 7 ref.Descriptors: *Activated sludge, *Mathematical model, *Industrial waste, Degradation (Decomposition), Waste water treatment, Design, Biochemical oxygen demand, Chemical oxygen demand, Energy, Mixing.
Identifiers: *Warburg.

A total of 19 separate Warburg runs were made on 15 different substrates. The oxygen uptake curves show the energy utilized during synthesis and endogenous respiration. The soluble COD curves illustrate the rate of removal of the substrate, while the insoluble COD curves show the incorporation of insoluble substrate into microbial mass. The most important aspect of the McKinney equations was considered in the analysis of this data: the basic energy synthesis relationship. It had previously shown for domestic sewage that in terms of the oxygen equivalents of biodegradable substrate that 1/3 of the substrate's total oxygen demand would be used for energy while 2/3 of the total oxygen demand would be converted into microbial protoplasm. This relationship was shown to be valid only for domestic sewage. The energy-synthesis proportionality constant K1 equals 0.50 for domestic sewage. However, new constants which are dependent on the nature of the waste have been measured. They are 0.33 for carbohydrates and 0.92 for non-carbohydrates. Other less substantiated K1 values are 0.92 and 0.71 for amino and fatty acids respectively. Use of data for design is discussed step by step and a sample program is presented. (Hancuff-Texas)
W70-07712

START-UP OF NEW WASTE WATER TREATMENT PLANTS,
Ontario Water Resources Commission, Toronto.

D. S. Caverly.

Journal of the Water Pollution Control Federation,
Vol 40, No 4, p 571-580, April 1968.

Descriptors: *Waste water treatment, *Sewage treatment, *Operation and maintenance, Digesters, Aeration, Chlorination, Education, Plants, Activated sludge.

Identifiers: *Start-up, *Check-out, *Routine, *Procedures.

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

The Ontario Water Resources Commission has developed a program of start-up procedures coupled with operator training that has proven beneficial in the commission's operations. The start-up procedures have been developed over a period of years with the operation of 93 waste water treatment plants as the guide. The start-up procedure consists of 4 days of intensive check-out followed by a series of inspections which last over a period of weeks. The first day is the most comprehensive including study of the blue prints with the plant operator and a full general explanation of each unit process. Before any waste water is permitted to flow into the plant, units must be inspected carefully during the dry check-out. The steps include inspection of the influent works, primary tanks, aeration tanks, digesters, and general overall mechanical equipment. For the wet check-out procedures are given for investigating the mechanical operations of the previously listed unit processes. Two detailed methods are given for the development of suspended solids in the mixed liquor. Of extreme importance in the start-up of a plant is acquainting the operator with the plant and the procedures he must follow to operate it properly. (Hancuff-Texas)

W70-07713

CLOSED LOOP CHLORINATION FOR WASTE WATERS,

Metcalf and Eddy, Inc., Boston, Mass.

Ariel A. Thomas, and Walter H. Brown.

Journal of the Water Pollution Control Federation, Vol 40, No 4, p 684-688, April 1968. 2 fig.

Descriptors: *Chlorination, *Automatic control, Waste water treatment, Costs, Design, Equipment, Chlorine, Coliforms.

Identifiers: *Closed loop chlorination, Dosage, Residual.

Closed loop chlorination provides a relatively inexpensive method by which all treatment plants can provide effective chlorination. Hardware to provide chlorination control by flow has been available and in satisfactory use for many years. It costs approximately \$5,000 and requires maintenance as does any instrumentation equipment. These instruments can replace four men required to measure chlorine residuals around the clock and actually compute continuous chlorine residuals which can be recorded. The information from chlorine residual instruments can be returned to controls which change the rate of chlorine feed to the waste water. This system of continually determining chlorine residual and continually adjusting the rate of chlorine feed to get a predetermined chlorine residual is called closed loop chlorination. The loop is formed by feeding back upstream control information. The future efficiency of treatment expected will make accurate manual control almost impossible, leaving closed loop chlorination the answer for economical and effective chlorination of treated and untreated waste waters. (Hancuff-Texas)

W70-07714

AIR TESTING SANITARY SEWERS,

Bloomington, Minn.; and Cherne Industrial, Inc., Hopkins, Minn.

Sam H. Hobbs, and Lloyd G. Cherne.

Journal of the Water Pollution Control Federation, Vol 40, No 4, p 636-642, April 1968. 10 fig, 1 tab.

Descriptors: *Sewers, *Testing, *Leakage, Pressure, Infiltration, Joints (Connections), Costs, Construction.

Identifiers: Television, Bloomington, Minnesota.

A test of every sewer line after construction is imperative. In the past, two types of accepted testing have been required: (1) a ball must be flushed through every section of the sewer pipe to insure against major structural failures, (2) infiltration or exfiltration tests must be made. The infiltration test consists of plugging the upper end section of a sewer and measuring the flow at the lower end. The exfiltration is performed by plugging the lower end

and measuring the flow required to maintain a level of 4 foot head. The present specifications permit leakage (infiltration or exfiltration) not to exceed 3.2 gallons per hour/100 ft of sewer. Air pressure loss was tested and found to correlate with exfiltration. A good straight-line correlation was found in clay pipe; however, no definite correlation applicable to all materials could be determined. For the clay pipe 1 psi pressure was almost equivalent to the exfiltration specification of 3.2 gallons per hour/100 ft. When attempting to locate severe leakage test plugs with a short length of cable and testing line are pulled through the sewer. These are spaced at 22 inch centers, pulled into position, inflated, pressure built up, tests made, and the plugs deflated and moved to the next position. Television inspection of several sewer line sections confirmed the results of air testing data. (Hancuff-Texas)

W70-07715

KINETICS OF MODEL AND FIELD EXTENDED-AERATION WASTE WATER TREATMENT UNITS,

Mississippi State Univ., State College.

E. Joe Middlebrooks, and C. F. Garland.
Journal of the Water Pollution Control Federation, Vol 40, No 4, p 586-612, April 1968. 27 fig, 5 tab, 59 ref.

Descriptors: *Activated sludge, *Kinetics, *Mathematical model, *Sewage treatment, Growth rate, Efficiency, Waste water treatment, Microorganisms, Prototypes.

Identifiers: *Extended aeration, Sludge volume index, Parameters.

Mathematical models were found to simulate the performance of actual field installations. Raw waste water was used as an influent substrate in the continuous flow model studies and its performance was found to be superior to that obtained with synthetic wastes. Non-flocculant solids appear to effect the periodic solids losses in the effluent as much as de-nitrification or hydraulic loading variations. The data collected from laboratory units using raw waste water to obtain design parameters are said to be applicable when determining the required mixed liquor suspended solids and the oxygen uptake rate for a given prototype system. Operation at high suspended solids level will increase variation in the effluent quality. The laboratory units showed that the specific organism decay rate increases with influent substrate concentration. (Hancuff-Texas)

W70-07716

PHOTOCHEMICAL DEGRADATION OF REFRACTORY ORGANIC COMPOUNDS,

Washington Univ., St. Louis.

Charles D. Bulla, III, and E. Edgerley, Jr.
Journal of the Water Pollution Control Federation, Vol 40, No 4, p 546-556, April 1968. 5 fig, 2 tab, 7 ref.

Descriptors: *Ultraviolet radiation, *Organics, *Degradation (Decomposition), Waste water treatment, Adsorption, Toxicity, Pesticides, Irradiation, Electromagnetic waves, Aldrin, Dieldren, Endrin.

Identifiers: *Photochemistry.

Photochemical reactions are initiated by the absorbance of electromagnetic radiation energy by an atom or molecule. This process elevates the absorbing species to a higher energy level usually causing the species to become unstable and through a deactivation process revert to a lower less energetic and more stable state. Investigation of the photochemical degradation of aldrin, dieldren, and endrin, in dilute aqueous solutions are made. All three compounds are subject to photochemical degradation by 2537A deg. electromagnetic radiations. Process variables; time, depth, and power may be related to the degradation rate of any one of the compounds studied by a convenient mathematical model. Temperature was shown to have no influence between the range of 20 deg. and 40 deg. C. A bioassay of blue gills

showed that the irradiated aldrin was less toxic than pure aldrin itself. Cost estimates for 50% degradation of pesticides at a 10 cm depth are given as \$24.50/10 to the 6th gal. for aldrin; \$73.00/10 to the 6th gal. for dieldren; \$57.50/10 to the 6th gal. for endrin. (Hancuff-Texas)

W70-07717

ENERGY INDUCED CHANGES IN AN AZO DYE STUFF,

AeroChem Research Labs., Inc., Princeton, N.J.; and Rutgers - The State Univ., New Brunswick, N.J.

Alan I. Mytelka, and Raymond Manganelli.
Journal of the Water Pollution Control Federation, Vol 40, No 2, Part 1, p 260-268, April 1968. 8 fig, 2 tab, 20 ref.

Descriptors: *Irradiation, *Cobalt radioisotopes, *Industrial waste, *Waste water treatment, Hydrogen ion concentration, Dissolved oxygen, Biochemical oxygen demand, Gamma rays.

Identifiers: *Dyestuff, *Ionizing, Chemical oxidation, Luminants, Sterilization, Solids.

A study of Color Index Direct Red 79 is made to determine the changes in properties after irradiation. The experimental conditions under which the irradiation took place were waste dilution of approximately 100:1, pH of 12.1 and a dose rate of 0.17 megarads/hour. Gas was bubbled through the waste at 40% oxygen and 60% nitrogen. After the absorption of 2.6 megarads, the COD was reduced 61%, TOC decreased 43% and for all practical purposes none of the dye remained. The ionizing radiation source was Cobalt 60 gamma radiation. The effect of ionizing radiation on the biodegradability was also studied. Increasing the dose improved the biodegradability of the waste from an initial value of 9 mg/l of oxygen uptake (5-day Warburg) with no irradiation, to 85 mg/l oxygen uptake with 2.5 megarads of irradiation. At the same doses the COD:BOD ratio decreased from 54.0 to 2.2. The latter figure is significant since it is approximately the same as domestic sewage. (Hancuff-Texas)

W70-07718

STUDY OF WASTE WATER FROM DYEWORKS (IN FRENCH),

E. Leclerc.

Bulletin du Centre Belge d'Etude et de Documentation des Eaux, No 23, p 39-51, 1954.

Descriptors: *Cotton, *Waste water treatment, *Sedimentation, *Pollution abatement, Biological oxygen demand, Solid wastes, Fish conservation.

Identifiers: *Dyehouse wastes, *Linen, Waste water analysis, Sizing wastes, Bleaching waste, Desizing, Textile mill wastes.

The characteristics of the various types of waste waters from the textile industry are described and methods of treatment are reviewed. Preliminary studies of the waste waters for works engaged in the bleaching and sizing of cotton and linen are reported. The effluent is settled in fiber sedimentation tanks in series before discharge at a rate of 550 cu m/hr to the river Lys. Analysis of samples taken from the spillway to the river revealed no significant variations in the character of the effluent. During the day the effluent satisfies the condensation for discharge to a third-class (industrial) river in every way except that the amount of settleable solids slightly exceeds the limit. The waste waters become reoxygenated in the first sedimentation tank. Sedimentation reduces the BOD of the waste waters from 270 mg to 111 mg/liter. The BOD of the river water is increased by 20% by the discharge of the effluent; it is already heavily polluted at this point by other trade waste waters. (Livingood-North Carolina State)

W70-07720

WASTE WATER REUSE,

New York State Department of Health, Albany.

Donald B. Stevens.

Waste Treatment Processes—Group 5D

Journal of the Water Pollution Control Federation, Vol 40, No 4, p 677-683, April 1968. 2 fig, 1 tab, 15 ref.

Descriptors: *Water reuse, *Tertiary treatment, Waste water treatment, Groundwater, Recharge wells, Injection wells.

While New York State is a comparatively water rich state it must provide a high degree of treatment to its waste water simply because every stream is a source of water supply. The present state of the art is such that a water meeting drinking water standards can be produced from the usual run of domestic waste waters. Emphasis must shift from the mere removal of pollutants from the mainstream of waste water to satisfactory disposal of this removal material. Two current studies are described in regard to the replenishment of groundwater well supplies. It is estimated that by the year 1977, the groundwater supply will be exceeded by the demand and rain alone will not be able to replenish the source. Plain I (Nassau County) is to augment the groundwater supply and simultaneously provide a hydraulic barrier to prevent salt water intrusion. Plan II (Long Island) provides for tertiary treatment which will produce an effluent that meets the drinking water standards. The second plan is also to be used for groundwater injection. (Hancuff-Texas)

W70-07721

NEW PROCESS TO REMOVE PHENOLS FROM WASTE WATER,

Humble Oil and Refining Co., Houston, Tex.

William L. Lewis.

Journal of the Water Pollution Control Federation, Vol 40, No 5, Part I, p 869-872, May 1968. 3 fig.

Descriptors: *Phenols, *Recovery, *Emulsions, Industrial waste, Waste water treatment, Costs, Oil, Biochemical oxygen demand, Distillation.

Identifiers: *Extraction, Catalytic cracking, Hydrocarbons.

A process to extract phenols from catalytic cracking distillate water recently was developed by Humble Oil and Refining Company. With a 12- x 40-ft electrostatic treating drum, this extraction technique can reduce the phenol content of cat-cracker distillate water up to 90%. The water treated, condensate distillate water, usually contains more than 300 mg/l of phenols. Because of the volume of condensate water normally is 5 to 15% of the hydrocarbon distillate volume, the total phenols in the effluent water stream can amount to several hundred pounds per day. By thoroughly mixing the distillate water with cycle oil and then allowing the emulsion to separate, the phenol partitions itself between the two immiscible liquids with most of it transferring to the hydrocarbon phase. This transfer is enhanced by a stimulated random motion of water particles brought about by a 20,000- to 40,000-volt potential. The installed cost of the device was less than \$200,000. (Hancuff-Texas)

W70-07722

TRAINING SANITARY ENGINEERING TECHNICIANS AT FAYETTEVILLE TECHNICAL INSTITUTE,

Fayetteville Technical Inst., N.C.

Howard E. Boudreau, and Charles A. Purcell, Jr. Journal of the Water Pollution Control Federation, Vol 40, No 5, p 857-864, May 1968.

Descriptors: *Training, *Personnel, *Sanitary engineering, Education, Schools (Education). Identifiers: *Operators, *Technicians, Technical school, Fayetteville, North Carolina.

A two-year program leading to the Associate of Applied Science degree in Sanitary Engineering Technology has been established at Fayetteville Technical Institute in North Carolina. The curriculum includes: mathematics, physics, chemistry, biology, fundamental of water and waste treatment,

drafting and surveying among its technical courses and also provides training in written and oral expression, economics, and psychology. An integral part of most of the technical courses is the laboratory work. Demand for graduates of the program has been high. (Hancuff-Texas)

W70-07723

LAND RECLAMATION—A COMPLETE SOLUTION OF THE SLUDGE AND SOLIDS DISPOSAL PROBLEM,

Metropolitan Sanitary District of Greater Chicago, Ill.

Frank E. Dalton, Jerome E. Stein, and Bart T. Lynam.

Journal of the Water Pollution Control Federation, Vol 40, No 5, p 789-804, May 1968. 14 fig.

Descriptors: *Sludge disposal, *Land reclamation, Sludge, Activated sludge, Costs, Fertilizers, Lagoons, Nitrogen, Phosphorus, Research and development, Illinois.

Identifiers: Wet air oxidation, Chicago (Ill), Solids.

The West-Southwest plant of Chicago handles approximately 825 tons/day of solids. In order to handle this load 4 methods are used: (1) heat dried activated sludge producing approximately 435 tons/day, (2) wet air oxidation process approximately 145 tons/day, (3) heated digesters, 100 tons/day, and (4) Imhoff tank sludge 145 tons/day. To this should be added 90 tons/day from the Calumet plant making a total of over 900 tons/day of sludge on a dry basis. The solids disposal cost is approximately 14.5 million dollars per year, or 46% of the annual maintenance and operation budget. A proposed land reclamation plan satisfying the following criteria is reviewed. (1) It must meet environmental standards, no air or water pollution, (2) it must solve the problem into perpetuity, (3) the method should be economical, and (4) the organic matter should be conserved for beneficial use. Implementation of the reclamation plant requires research and careful planning. Of special interest is that portion of the plan for liquid as well as solid disposal. Some areas utilizing waste for land reclamation are documented. (Hancuff-Texas)

W70-07724

DESIGNS OF A MODERN MEAT PACKING WASTE TREATMENT PLANT,

Giffels and Rossetti, Inc., Detroit, Mich.; and Florida State Board of Health, Jacksonville.

E. Willoughby, and V. D. Patton.

Journal of the Water Pollution Control Federation, Vol 40, No 1, p 132-137, Jan 1968.

Descriptors: *Industrial waste, *Waste water treatment, *Design, Operation and maintenance, Costs, Activated sludge.

Identifiers: *Meat packing, Loading.

A brief description is given of the in-plant actions taken to eliminate the sources of pollution through their reclamation. For example, all the viscera, horns, hooves, and other inedibles were hashed and cooked, and the grease reclaimed. The process chosen for the unreclaimable portion of the wastes was extended aeration modification of activated sludge. The basic components of the system as designed and installed include a sedimentation and grease skimming facility, extended aeration, and aerobic digestion. The aerobic digestion system consists of two aeration tanks and an aerobic tank, final settling tank, with an air-lift sludge return system, 5-acre aerobic stabilization pond, multi-stage air compressor facility, chlorination facility, and detention pond. Testing of composite samples over a month period indicated that: (1) the biological load was about equal to the design load of 2,000 lbs. BOD per day, (2) the hydraulic load was about 160% of the design basis of 315,000 gal/day, (3) BOD removal averaged 95%, (4) suspended solids removal averaged 84%, (5) Settleable solids removal averaged 98%, (6) grease removal averaged 98%. Total cost of the facility was about \$250,000. (Hancuff-Texas)

W70-07725

HYDRAULIC MODEL STUDIES OF CHLORINE MIXING AND CONTACT CHAMBERS,

Harza Engineering Co., Chicago, Ill.

David S. Louie, and Martin S. Fohrman.

Journal of the Water Pollution Control Federation, Vol 40, No 2, Part 1, p 174-184, Feb 1968. 6 fig, 3 tab.

Descriptors: *Chlorination, *Model studies, Mixing, Design, Flow profiles, Head loss, Baffles, Costs.

Identifiers: Diffusers, Detention time.

Because of the size and cost of the proposed post-chlorination facility for Metropolitan Sanitary District of Greater Chicago (330 MGD) it was decided that an extensive model study would be desirable. The scale finally decided upon was 1 to 10, and because of the physical largeness of the model, results were considered to be more reliable than usually could be extrapolated from a model to prototype. Since the prototype was to consist of two symmetrical batteries it was necessary to model only one half of the prototype. Confetti and dye were used for visual observation of mixing in the mixing chamber and distribution of flow in the contact chamber. Five basic contact chamber schemes were tested for their comparative performances from the standpoint of flow patterns, head loss, and detention time. The results of the study on the mixing chamber and diffuser system provided an effective means of evaluating the methods of introducing and mixing chlorine with the plant effluent. The most efficient design for the contact chamber was a van-baffle system. The scheme was superior for the following reasons. (1) It had lowest head loss of all the schemes studied. (2) It had the highest minimum and mean detention time. (3) It was the most desirable of all schemes as regards sedimentation because of a more uniform flow pattern. (Hancuff-Texas)

W70-07726

FLOCCULATION OF BULKED ACTIVATED SLUDGE WITH POLYELECTROLYTES,

Northwestern Univ., Evanston, Ill.

Phillip C. Singer, Wesley O. Pipes, and Edward R. Hermann.

Journal of the Water Pollution Control Federation, Vol 40, No 2, Part 2, p R1-R9, Feb 1968.

Descriptors: *Activated sludge, *Flocculation, *Sphaerotilus, Sludge, Coagulation, Costs, Sewage treatment, Electrolytes.

Identifiers: *Bulking, *Polymer, Settling.

Bulk sludge can be flocculated and certain cationic polyelectrolytes are flocculants of bulk activated sludge. The optimum concentration for the two cationic polymers studied were found to depend on the initial sludge volume index and on the suspended solids content. The greater the suspended solids concentration, the greater was the polymer requirement, and the greater the final settled volume. As more polymer is added beyond the point of maximum flocculation, the floc becomes larger resulting in greater settled volume due to trapped water. The use of cationic polymers in flocculated bulk sludge resulted in the discharge of a clear stable effluent at dosages of between 2 and 3 mg/l. However, it was also found to be successful at a dosage of 50 mg/l. The treatment costs were: alum, \$9.40/million gallons; cationic polymer A, \$6.50/million gallons; cationic polymer B, \$20.00/million gallons. Sludge once coagulated by a polymer seemed resistant to subsequent polymer coagulation during experiments of recycling of sludge. (Hancuff-Texas)

W70-07727

THE BIODEGRADABILITY AND TREATABILITY OF NTA,

Proctor and Gamble Co., Cincinnati, Ohio.

J. E. Thompson, and J. R. Duthie.

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

Journal of the Water Pollution Control Federation, Vol 40, No 2, Part 1, p 306-319, Feb 1968. 10 fig, 2 tab, 15 ref.

Descriptors: *Biodegradation, *Detergents, Activated sludge, Waste water treatment, Sewage treatment, *Laboratory tests, Degradation (Decomposition), Surfactants.

Identifiers: Trisodium nitrilo triacetate (NTA), Laboratory scale.

The use of NTA in combination with polyphosphates has been found to be effective as a detergent builder. As an ingredient in detergents, NTA becomes a component of waste water and therefore the biodegradability and treatability of NTA are of interest to the detergent industry and to others concerned with waste water treatment and water supply. The results of this study show that NTA is metabolised to carbon dioxide, water, and inorganic nitrogen by microorganisms present in waste water and river water; thus NTA is biodegradable. The biodegradation process is suggested as an initial cleavage and immediate metabolism of two acetate groups followed by metabolism of the glycine fragment. Measurements of oxygen utilization by microorganisms metabolising NTA indicate that carbonaceous oxygen demand was 59% of theoretical in 5 days, and 91% in 13 to 20 days. The rate and extent of NTA degradation was found to be comparable to those of glucose and citric acid. It was found to be removed from waste water by the activated sludge process, have no effect on primary and secondary settling, nor on sludge digestion, and would degrade rapidly when entering rivers or lakes. A zinc-zinc analytical method for the detection of NTA is presented in an appendix. (Hancuff-Texas)

W70-07728

SUBSTRATE UTILIZATION AND HIGH BIOLOGICAL SOLIDS CONCENTRATION, Oklahoma State Univ., Stillwater.

P. Krishnan, and A. F. Gaudy, Jr.

Journal of the Water Pollution Control Federation, Vol 40, No 2, Part 2, p R54-R66, Feb 1968. 8 fig, 1 tab, 23 ref.

Descriptors: *Activated sludge, *Concentration (Composition), *Kinetics, *Degradation (Decomposition), Sewage treatment, Waste water treatment, Chemical oxygen demand, Adsorption, Carbohydrates, Sludge, Protein, Microorganisms, Metabolism.

Identifiers: *Biological solids, Warburg.

Laboratory-scale studies of batch activated sludge units with glucose and sorbitol as carbon sources showed that no relation existed between immediate uptake and initial solids concentration, for concentrations of 1,500 to 4,700 mg/l. It was observed in making studies with sorbitol and glucose and other studies in the laboratory, that during substrate removal using relatively high initial biological solids, most of the substrate is channeled into carbohydrate synthesis and that after this, protein is synthesized from the carbohydrate store, i.e., the two syntheses are observed to occur in essentially a sequential manner. The ability of high solids systems to remove substrate in the complete absence of protein synthesis is rigorously demonstrated by the experiment using chloramphenicol. The results of the sorbitol experiments throw a particular light on the question of adsorption as a primary mechanism of substrate removal. No evidence for adsorption could be found, but additional evidence for the purely biochemical mechanism is put forth. (Hancuff-Texas)

W70-07729

TECHNOLOGY AND ECONOMICS OF SEWAGE TREATMENT (IN GERMAN), For primary bibliographic entry see Field 05A.

W70-07730

EFFECTS OF AMINO ACIDS ON ANAEROBIC DIGESTION, Texas Univ., Austin.

Ernest M. Miholits, and Joseph F. Malina, Jr. Journal of the Water Pollution Control Federation, Vol 40, No 2, Part 2, p R 42-53, Feb 1968.

Descriptors: *Anaerobic digestion, *Amino acids, Digestion, Biomass, Waste water treatment.

Identifiers: *Warburg analysis, *Radioactive tracers, Substrate, Labelled, Removal, Laboratory scale.

In this study single non-radioactive amino acids, as well as labelled L-C-14 amino acids were added to digested starch, and the effects of this compound on quantity and quality of gas production were recorded. Laboratory scale digestion units and manometric techniques were used in these studies. The results show that micromole quantities of leucine, methionine, alanine, glycine stimulate gaseous production of an anaerobic system. Normal parameters, pH, alkalinity, and volatile acid concentrations, all of which are rough parameters which tell nothing of the variations occurring in the microbial population in localized portions of the digester may fail to indicate actual performance, while amino acid concentration and gas production values may be more meaningful. (Hancuff-Texas)

W70-07731

USE OF COMPUTERS IN DESIGN OF SANITARY SEWER SYSTEMS, Polytechnic Inst. of Brooklyn, N.Y.

P. R. DeCicco, H. F. Soehngen, and J. Takagi. Journal of the Water Pollution Control Federation, Vol 40, No 2, Part 1, p 269-284, Feb 1968. 15 fig.

Descriptors: *Design, *Sewers, *Computers, Systems analysis, Data processing, Flow, Programs, Costs, Evaluation, Analysis.

The electronic computer techniques developed for the design of municipal sanitary waste water collection systems include linked programs for estimation of design flow, design of sewers, computation of partial flow characteristics, and estimate of costs. The system recently was applied to the design of Merrick Harbor Collection District system in Nassau County, New York, which has an area of about 5 sq.mi. and an ultimate population of 39,500. The programs are applicable to any area, regardless of size, topography, configuration, or other special characteristics. Inputs include basis for estimating design flows, sewer design criteria, demographic, topographic and geologic data and sewer layout requirements. The program also accepts information about potential obstructions and locates sewers to avoid interference. The computerized procedure improved both quality and quantity of output and released engineering personnel from routine computations. (Hancuff-Texas)

W70-07732

OPTIMIZATION OF THE HYDRAULIC REGIME OF ACTIVATED SLUDGE SYSTEMS, Kansas State Univ., Manhattan.

Larry E. Erickson, and Liang-tseng Fan. Journal of the Water Pollution Control Federation, Vol 40, No 3, p 345-362, March 1968. 14 fig, 3 tab, 22 ref. OWRR B-001-KAN.

Descriptors: *Activated sludge, *Mathematical model, *Hydraulics, *Optimization, Biological treatment, Sewage treatment, Costs, Economics, Waste water treatment, Aeration, Concentration (Composition), Efficiency.

The systems approach is taken to simulate and mathematically optimize a combination of process and economic models for activated sludge. Mathematical models are given for the growth kinetics of biological systems, hydraulics of completely mixed tanks in series, and economic considerations as capital and operating costs. A combination of the kinetic, hydraulic, and economic models is made and approached from a minimum cost standpoint.

Several tables are presented giving design constants for various biological k rates for systems with 90% and 99% treatment. Mathematical optimization techniques can be used to obtain useful information about the activated sludge system. K1 a dimensionless organic nutrient concentration at which the specific growth rate is one half the maximum value is a very important variable in the design of an activated sludge system. The optimum allocation of volumes for two aeration tank activated sludge systems changes significantly with changes in K1. Results of analyses of completely mixed aeration tanks show that the theoretical volume requirement for an optimal 2 aeration tank activated sludge system is less than for a system of a single aeration tank. (Hancuff-Texas)

W70-07733

TECHNIQUES AND FACTORS INVOLVED IN AERATOR SELECTION AND EVALUATION, Dow Chemical Co., Midland, Mich.

Rudy G. Novak.

Journal of the Water Pollution Control Federation, Vol 40, No 3, Part 1, p 452-463, March 1968. 11 fig, 2 tab.

Descriptors: *Oxygenation, *Aeration, *Equipment, Efficiency, BOD, Design, Industrial waste, Waste water treatment, Oxygen, Sewage treatment. Identifiers: *Oxygen transfer, Mechanical aerators, Power, Uptake rate.

Oxygenating efficiencies of aerators measured during steady-state operation are not accurate enough to determine compliance with performance guarantee. Oxygenating efficiencies measured during steady-state operation are better indicators of relative performance than absolute performance. The absolute oxygenating efficiency of an aerator can be measured best by a study of individual aerator oxygenation performance under non-steady state operation in a basin sized to permit accurate determination of the required data. Two different types of aeration equipment were studied: a mechanical propeller-type mixer, and an ejection aeration system. Results from the mechanical aerator study showed that transfer under standard conditions was 4.1 lb O₂/HP-hr and evaluation of the ejector showed a value of 4.3 lb O₂/HP-hr. Oxygen uptake rates were determined by plotting C_s-C₁ versus time for mixed liquor and pure water. From these K_{LA} values were determined. Other parameters evaluated include chemical oxygen demand, biochemical oxygen demand, sludge volume index, suspended solids and mixed liquor velocity. Factors which must be considered in aerator evaluation were said to be basin configuration, fluctuating liquid levels, waste water solids, and alpha and K_{LA} values. (Hancuff-Texas)

W70-07734

OXYGENATION EFFICIENCY OF A BLADED ROTOR, Iowa State Univ., Ames.

John L. Cleasby, and E. Robert Baumann.

Journal of the Water Pollution Control Federation, Vol 40, No 3, p 412-424, March 1968. 8 fig, 18 ref.

Descriptors: *Oxygenation, *Rotors, Design, Pilot plants, Dissolved oxygen, Aeration, Concentration (Composition), Efficiency, Pressure, Temperature, Turbulence, Waste water treatment.

Identifiers: *Mechanical aerators, Diffusers, Power.

Increased use of many modifications of the activated sludge waste treatment process has focussed attention on the need for efficient aeration devices. The results of a study performed on a bladed rotor mechanical aeration device is reported. The oxygenation capacity at speeds of 60 to 120 RPM and rotor immersions of 3 to 12 inches ranged from 3.4 to 5.0 O₂/HP-hr under standard conditions. The actual oxygenation capacity under standard conditions including the power required for motor, gear reducer, and rotor should be approximately 75% of the above values. Forty-five ex-

perimental runs were conducted covering five different rotor speeds and four different rotor immersions. Because of difficulty analyzing data reported in the literature for diffused aeration systems (reported as a per cent oxygen absorption), the rotor studies were compared with one typical hypothetical diffused aeration installation. The rotor system was found to be much more efficient with the diffused air system producing 0.81 lb O₂/HP-hr. (Hancuff-Texas)

W70-07735

A NEW PRODUCT CONCEPT FOR IMPROVEMENT OF INDUSTRIAL WATER, Du Pont de Nemours (E. I.) and Co., Wilmington, Del.

William T. Robinson, and Robert J. Mattson.
Journal of the Water Pollution Control Federation, Vol 40, No 3, p 439-446, March 1968. 9 fig, 6 tab, 1 ref.

Descriptors: *Industrial waste, Membrane processes, Reverse osmosis, Waste water treatment, Efficiency, Biochemical oxygen demand, Concentration (Composition).

Identifiers: *Refractory organics, Fibers, Polymers.

Du Pont is conducting research on the potential application of polymeric membranes as a new process for industrial waste treatment. In many areas the largest advantage for using membrane separation technique is that materials which are pollutants at low concentrations may be reusable at higher concentrations. Results of a study on processes using small diameter hollow fibers are reported. The most common sizes range from 25 to 250 microns OD with wall thicknesses of 5 to 50 microns. The permeators used for study are 6 inches in diameter and have a length up to 7 feet. It is indicated that polymeric membranes differ in their ability to reject specific ions. An example is given whereby the chloride ion has 0% rejection and where the phosphate ion has 99%. Therefore, the possible degree of concentration would be much higher because the process would not have to work at a higher pressure to overcome the osmotic pressure of the chloride ions. Results of membrane rejection at 400 psig showed a COD reduction from 212 mg/l to 66, indicating a rejection of 69%. (Hancuff-Tex-

as)

W70-07736

THE DISPOSAL OF NYLON WASTES, Chemstrand Corp., Pensacola, Fla.

E. D. Remy, and D. T. Lauria.
Proceedings of the Industrial Waste Conference, 13th, 1959, p 596-624. 12 fig, 12 ref, 4 tab.

Descriptors: *Activated sludge, *Solvents, *Waste water treatment, Lagoons, Sedimentation, Flotation, Disposal, Streams.

Identifiers: *Nylon 66, Combustion, Adipic acid, Nylon salt, Solvent stripping, Man-made fiber plant wastes.

At the plant of Chemstrand Corporation near Pensacola, Florida, manufacturing nylon 66, the waste waters were formerly stored in lagoons and discharged to the Escambia River during periods of high flow. When the plant was expanded, however, treatment of the waste waters became necessary. The more concentrated waste waters were burned to recover heat. Of the remaining waste waters, about 90% came from the manufacture of adipic acid, a principal component of nylon salt. Detailed studies were made on the treatment of these waste waters; the results are discussed, and shown in tables and graphs. It was found that one stream of adipic acid waste was best treated by solvent stripping, using a submerged combustion process. The stripped waste water could then be mixed with the second stream for biological treatment by the activated sludge process. Sedimentation was found to be more effective than flotation for recovery of sludge. Based on the laboratory and pilot-plant studies, a full-scale treatment plant was put in operation in 1957 and has operated efficiently. (Livengood-North Carolina State)

W70-07741

GOOD HOUSEKEEPING IS BEST SOLUTION TO STREAM POLLUTION, Massachusetts Inst. of Tech., Cambridge. For primary bibliographic entry see Field 05B.

W70-07756

TREATMENT OF WOOL SCOURING WASTES, Worthen H. Taylor. Sanitrol, Vol 1, p 13-14, 1952.

Descriptors: *Calcium chloride, Centrifugation, Turbidity, Suspended load, *Waste water treatment.

Identifiers: *Wool grease, *Wool scouring wastes.

This article relates to the treatment of wool scouring wastes by the addition of CaCl₂ and centrifuging in a Sharples DG-2 centrifuge. This method resulted in a reduction of wool grease, turbidity, and suspended solids by 98-99 percent. The amount of CaCl₂ used varied from 0.25 to 1.5 percent of the total weight of the wastes treated, the amount depending on the concentration of the wastes. However, wool scouring wastes resulting from the use of a minimum quantity of water in scouring required less chemicals. The success of the process is adding the solution of CaCl₂ three seconds before centrifuging and then holding the effluent in a skimming tank from 20 to 30 minutes. Temperature had little effect upon the process. (Livengood-North Carolina State)

W70-07758

BIOLOGICAL TREATMENT OF MIXTURES OF HIGHLY ALKALINE TEXTILE-MILL WASTE AND SEWAGE,

Cone Mills Corp., Greensboro, N. C.
R. H. Souther, and T. A. Alspaugh.
American Dyestuff Reporter, Vol 44, p 390-395, 1955. 1 fig, 10 tab, 7 ref.

Descriptors: *Sewage effluents, *Trickling filters, *Activated sludge, Biochemical Oxygen Demand, Color, Domestic wastes, Pilot plants, Waste water treatment, *Biological treatment.

Identifiers: *Textile mill wastes, Alkaline wastes, Finishing wastes, Dyehouse wastes.

Pilot plants studies are being made on the treatment of mixtures of domestic sewage and textile-mill dye and finishing wastes by high-rate trickling filters, by activated sludge, and by chemical treatment to determine the most economical and most efficient method for treating such a mixture. Results indicate that pretreatment through a trickling filter and subsequent treatment through activated sludge is the most efficient method and can be satisfactorily used for treating highly alkaline textile wastes. An usually high removal of BOD and color is obtained. Certain process changes in the plant were also made to reduce the BOD loading through the treatment plant. (Livengood-North Carolina State)

W70-07760

PURIFICATION OF THE SEWAGE WATERS FROM RAYON MANUFACTURING (IN RUSSIAN), V. S. Morgenshtern, Ya. Z. Sorkin, Yu. E. Matuskov, and V. A. Malikov. Khimicheskie Volokna, Vol. 1, p44-47, 1966. 1 fig, 3 tab.

Descriptors: *Lime, *Waste water treatment, Sulfates, Sodium sulfate, Sulfides, Cellulose, *Chemical precipitation, Surface waters, Setting basins, *Effluents.

Identifiers: *Textile wastes, Sulfuric acid, Zinc compounds, Carbon disulfide, Grease, Rayon (Regenerated cellulose fibers), Regeneration, Baths, Clarifying agent, Suspended residues, Contact clarifier, Soda, Sodium sulfide, Staple fibers.

Waste waters containing sulfuric acid, corrosive nitrogen compounds, sulfates of sodium and zinc, carbon disulfide, hydrogen and other sulfides, thiocarbonates, cellulose pulp, and grease result from rayon manufacturing. Today viscose rayon plants use regeneration of the plasticization, and precipitation baths to reclaim chemicals and to clean wastes to meet regulations protecting surface reservoirs. Lime is used as a reagent in a two-stage scheme of purification. Settling tanks or clarifying agents handle suspended residues and a contact clarifier guarantees removal of zinc from the effluent. Soda and sodium sulfide are used to regenerate zinc from effluents of the manufacture of high-strength rayon tirecord and staple. (Lonon - North Carolina State)

W70-07778

A DYNAMIC MODEL OF THE ANAEROBIC DIGESTION PROCESS,

Clemson Univ., S.C. Dept. of Environmental System Engineering.

John F. Andrews.

Proceedings of the Industrial Waste Conference,

23rd, 1969, p 285-310. 18 fig, 1 tab, 31 ref.

Descriptors: *Anaerobic digestion, *Simulation analysis, *Inhibition, *Hydrogen ion concentration, *Mathematical model, Anaerobic bacteria, Laboratory tests, Waste water treatment.

Identifiers: *Volatile acid concentration, *Process stability.

Process stability has been the major problem associated with the anaerobic digestion process. A dynamic model which utilizes an inhibition function to predict the failure of an anaerobic digester was presented. The key features of the model were: (1) the use of an inhibition function to relate volatile acid concentration and specific growth rate for the methane bacteria; and (2) consideration of the un-ionized acid as the growth-limiting substrate and inhibiting agent. The consideration of the un-ionized acid as the inhibiting agent resolves the conflict between volatile acid inhibition and pH inhibition because the concentration of un-ionized acid is a function of both total volatile acid concentration and pH. The model was kept as simple as possible by assuming that there was no lag phase, organism death, endogenous respiration, substrate utilization for maintenance energy, or inhibition byproducts. Experimental evidence from laboratory studies and evidence from the bacteriological literature were presented in support of the model. Simulation studies, utilizing a digital-analog simulation program (PACTOLUS), of both batch and continuous flow systems provided additional evidence by predicting results commonly observed in the field during the start-up, or failure, or recovery of anaerobic digesters. The simulation studies should be considered as only semiquantitative as reliable values of the growth parameters were not available. (Galwardi-Texas)

W70-07804

ANNUAL DIGESTER UPSET CORRECTED, San Mateo Waste Water Treatment Plant, Calif.

John P. Lee.

Water and Sewage Works, Vol 116, No 2, p 56-58, Feb 1969. 1 fig, 3 tab.

Descriptors: *Anaerobic digestion, *Operation and maintenance, *Waste water treatment, Hydrogen ion concentration, Lime, California, Activated sludge, Sludge digestion.

Identifiers: *Volatile acids, Carbon dioxide, Gas production, San Mateo (Cal).

San Mateo, California has experienced three identical primary sewage digester upsets in the past three years at its municipal waste water treatment plant. The primary digester handles approximately 20,000 gallons of thickened sludge per day. The upsets were characterized by (1) an increase in the volatile acid content of the digester, (2) an increase in the carbon dioxide fraction of the gas produced and (3) a dramatic decrease in gas production.

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

Operational data were presented for the periods just before, during and after correction of the upsets for each of the three years. For instance, volatile acid content increased from 108 to 2070 mg/l while CO₂ increased from 27 to 43 and gas production decreased from 91,600 to 47,200 cu. ft. during the upset of 1966. The breaking up of the grease blanket on the top of the digester at the start of warm weather increased the activity of the acid-forming bacteria. Control of the upsets was obtained by the addition of up to 600 pounds of lime and the diversion of the raw sludge to the secondary digester. (Galwardi-Texas)

W70-07805

START-UP PROBLEMS AT A METROPOLITAN DISTRICT PLANT,

Metropolitan Denver Sewage Disposal District No. 1, Commerce City, Colo.

Louis D. Kifer.

Journal of the Water Pollution Control Federation, Vol 40, No 7, p 1338-1345, July 1968.

Descriptors: *Sewage treatment, *Operations, *Failures, *Equipment, Control systems, Waste water treatment, Sludge disposal, Chemicals, Incineration, Pumps, Irrigation, Personnel.

Identifiers: *Blowers, Suspended solids, Air flow, Start-ups.

The large number of start-up problems encountered at the Metropolitan Denver Sewage Treatment Plant in Colorado are described. The plant includes primary treatment for part of the wastes and activated sludge for treating both these and wastes given primary treatment elsewhere. Initial start-up problems included foam build-up on the primary tanks due to clogging of the foam dispersion spray system (cured by utilizing secondary effluent in place of primary). All four blowers of the plant failed within 74 hours after the start of operation. This was due to the veins pulling away from the main portion of the wheel, resulting in striking the casing. After the second start-up further problems developed. These included improper hydraulic control of the aeration tanks; deposition of oil fractions in the control system; air drops due to leaking at knee joints, caked grease in the tank due to underdesign of pumps; difficulty in furnishing adequate volumes of sludge to the vacuum filters; and further problems in sludge conditioning, drying, incineration and further difficulties in blower operation. (Hancuff-Texas)

W70-07806

CENTRAL PRE-TREATMENT OF OMAHA PACKING HOUSE WASTE WATERS,

Omaha Dept. of Public Works, Nebr.

E. Bruce Meier, and William E. Korbitz.

Journal of the Water Pollution Control Federation, Vol 40, No 4, p 627-636, Apr 1968. 10 fig, 1 tab.

Descriptors: *Industrial waste, Waste water treatment, Design, Sedimentation, Financing, Profit, Costs, Farm wastes, Livestock wastes, Cattle, Hogs, Sheep.

Identifiers: *Meat packing, Flotation, Solids, Collection, Fats, Greases, Processing.

The daily kill day discharges of waste water from the meat packing operations in the City of Omaha average more than 15 million gallons and contain at least 70 dry tons of suspended solids in addition to approximately 25-40 dry tons of animal fat. The suspended solids are predominantly kill floor scraps and paunch manure from cattle, hogs and sheep. The simple and inexpensive method of paunch manure and grease disposal by sluicing from the premises is no longer acceptable. The difficulty of owning and operating privately 18 separate facilities would be difficult if not impossible. The City and industry joined hands in an effort to find an economically feasible solution. The final solution involved the design of collector sewer systems, gravity settling basins, conventional dewatering and conveying facilities, air floatation units, solids and skimmings storage, and a continu-

ous dehydration system for skimmings using oil as a process vehicle. The pre-treated waste water will be discharged to the city sewers. Total estimated cost of the Omaha plant is 6.7 million dollars and will be financed chiefly by bonds. The bonds will be funded from revenues derived from the sale of processes grease recovered from the two-stage facility, and by payments from individual packing companies. (Hancuff-Texas)

W70-07807

SUBSTRATE UTILIZATION IN HETEROGENOUS COMMUNITIES,

Harvard Univ., Cambridge, Mass.

Elisabeth Stumm-Zollinger.

Journal of the Water Pollution Control Administration, Vol 40, No 5, Part 2, p R213-R220, May 1968. 4 fig, 4 tab, 25 ref.

Descriptors: *Microorganisms, *Biodegradation, *Cultures, Bacteria, Natural streams, Activated sludge, Growth rates.

Identifiers: *Heterogenous systems, Glucose, Consumption, Substrate utilization.

Mixed laboratory cultures growing on non-selective multi-substrate medium do not simulate satisfactorily a natural bacterial population because accumulation leads to selective enrichment of one or several types. A mixed acclimated laboratory culture resembling a natural community in kind and relative abundance can be reconstituted from pure cultures of natural isolates. The slowly growing bacteria of natural waters can utilize many substrates concurrently, but sequential substrate utilization can occur where a few substrates predominate in solution enriching the microorganisms favored by these substrates. Sequential substrate utilization was observed in coliform dominated cultures. (Hancuff-Texas)

W70-07808

PRETREATMENT OF SEWAGE SLUDGE,

Technische Hochschule, Aachen (West Germany).

Institut fuer Siedlungswasserwirtschaft.

B. Boehnke.

4th International Congress of the IRGR, (International Research Group on Refuse Disposal) Based, 2-5 June 1969, working group 5, p 608-614. 1 fig, 1 tab.

Descriptors: *Sludge, *Sludge disposal, *Sludge treatment, *Sewage sludge, *Sewage disposal, *Sewage treatment, *Sludge digestion, Aerobic treatment, Anaerobic digestion, Dewatering, Drying, Filtration, Vacuum drying, Centrifugation.

Identifiers: *Sludge pre-treatment, Aerobic digestion.

Solid waste and sludge production in West Germany amount to some 50 x 10 6m³ per year, of which 40% or 20 x 10 6m³ is raw, unthickened sewage sludge. With increasing population and decreased agricultural use of sewage sludges as fertilizer, new methods of treatment and disposal must be found. Methods of disposal acknowledged by experts include incineration, composting, and tipping (sanitary landfill). Sludge processing must fulfill two basic requirements. (1) The sludge must be stabilized through decomposition of high value proteins and carbohydrates into low valued ones. (2) volume must be reduced by removal of ballast water. The 20 x 10 6m³ sludge produced yearly in West Germany, if treated anaerobically and dried to 60% water, could be reduced in volume to 2.4 x 10 6m³ of a paste-like material and easily stored. Dehydration to 60% water yields a tenfold disposal volume, but further dehydration to 40% water content increases disposal volume only another 50%. Further reduction in water content uneconomical. Dehydration may be achieved by centrifugation or filtration. Both processes are discussed briefly. (Makela-Texas)

W70-07809

CHEMICAL PROCESSING OF WASTE WATER FOR NUTRIENT REMOVAL,

Stanford Univ., Calif.

Rolf Eliassen, and George Tchobanoglou.

Journal of the Water Pollution Control Federation, Vol 40, No 5, Part 2, p R171-R180, May 1968. 22 fig, 4 tab, 9 ref.

Descriptors: *Nutrients, *Nitrogen, *Phosphorus, *Waste water treatment, *Costs, Chemicals, Absorption, Chemical precipitation, Electro-dialysis, Disposal, Efficiencies, Ion exchange, Sewage treatment.

Identifiers: *Methods, Removal.

Nutrient removal methods can be classified as biological, chemical and physical. Chemical methods for the removal of nitrogen include ammonia stripping, ion exchange, and electro-chemical treatment. Chemical precipitation, ion exchange, sorption, and electro-chemical treatment are also available for removal of phosphorus. Typical removal efficiencies are 80-98% nitrogen and 85-99% for phosphorus. The key factors in planning and designing nutrient removal facilities are the nutrients to be removed, the use of treated waste water, means for ultimate disposal of contaminants, and economic feasibility. Costs for different processes vary widely. For example, soil spreading varies between \$0.001 to \$0.3/1000 gal. While deep-well injection varies between \$13 and \$27/1000 phosphorus removal varies between \$40 and \$70 per million gal. (Hancuff-Texas)

W70-07810

THE TREATMENT OF KIER LIQUOR IN AD-MIXTURE WITH SEWAGE,

Sewage Works, Saddleworth (England).

K. A. Deighton.

Water Pollution Control, Vol. 66, No. 5, p 484-491, 1967. 8 tab.

Descriptors: *Activated sludge, *Waste water treatment.

Identifiers: *Textile mill wastes, *Pulp mill wastes, Caustic liquor, Kier process.

The Greenfield, Lancaster, England sewage disposal system was quite capable of handling the trade waste from the area, including some textile mills and dye houses until a cigarette paper purifying plant was built. Studies showed that the caustic liquor from the kier boiling of pulp would over load it. Laboratory and pilot plant experiments developed methods and modifications in the sewage plant. It was found that sewage containing kier liquor and other trade effluents could be successfully purified by two-stage treatment using a partial-treatment activated-sludge plant followed by biological filtration. While no set of conditions ensured a 30:20 effluent at all times, departures from this were generally slight. On average, during the later stage of the experiment, effluents were within the 30:20 standard. (Work - North Carolina State University)

W70-07811

EFFECTIVE MIXING ENERGY ON SLUDGE YIELD AND CELL COMPOSITION,

Oklahoma State Univ., Stillwater.

M. D. Rickard, and A. F. Gaudy, Jr.

Journal of the Water Pollution Control Federation, Vol 40, No 5, Part 2, p R121-R144, May 1968. 11 fig, 2 tab, 20 ref.

Descriptors: *Mixing, *Activated sludge, *Microorganism, Dissolved oxygen, Sewage treatment, Biological treatment, Sludge, Laboratory scale, Waste water treatment, Chemical oxygen demand, Biological oxygen demand, Turbulence, Bacteria.

Identifiers: *Agitation, *Compositions, RNA, DNA.

Operation of a steady-state bacterial system at a constant dilution rate with varying agitation rates has shown that solids yield and oxygen uptake both

vary with the amount of agitation provided. As a measure of agitation, the average velocity gradient G was measured. The decrease in solid yield with increasing turbulence appears to occur primarily at the expense of cellular carbohydrate. This results in the production of a sludge having a higher protein content at a higher agitation rate. On the basis of literature cited, and work presented five mechanisms are advanced to explain the increased oxygen uptake and decrease in solids yield. These are: (1) change in predominance, (2) increased frequency of contact between cells and substrate, (3) production of smaller floc particles with resultant improved penetration of substrate and oxygen, (4) increase in the rate of oxygen transfer across cell liquid interfaces, (5) maintenance of a higher DO concentration with increasing turbulence. Although none of these mechanisms can be eliminated, the increased oxygen uptake probably results from the reduction in the cell liquid interfacial resistance to oxygen transfer with increase of mixing energy and decrease in the biological solids yield probably results from an increased ratio of respiration to synthesis. (Hancuff-Texas)
W70-07812

DESIGN AND OPERATION OF THE FIRST DIGESTER GAS TURBINE IN THE U.S.A.,
Carollo (John) Engineers, Lafayette, Calif.
H. Harvey Hunt, and William N. Clarke, Sr.
Journal of the Water Pollution Federation, Vol 40,
No 7, p 1346-1357, July 1968. 4 fig.

Descriptors: *Turbines, *Digestion, *Fuels,
Sludge, Waste water treatment, Costs, Operations,
Design, Sewage treatment, Sludge digestion.
Identifiers: *Power generation, *Gas turbine engine.

The gas turbine now in operation at the County Sanitation Districts of Orange County, California, is the first in the United States and the second in the world to utilize waste digester gas as a fuel. The paper presents the thinking and decisions which lead to the turbine system's design, installation and operation. The turbine generator is suited ideally for peaking and stand-by power generation as it is not necessary to start a boiler and wait for steam generation before power can be produced. Also the turbine requires much less space than the diesel engine. The unit is light weight and can produce 70 to 140 kilowatts of electrical energy per ton of total machinery as compared to 27 kilowatts per ton with the diesel engine. One of the biggest advantages of the gas turbine is that no water is needed for either cooling or power, with the exception of water required to cool the gas. The turbine purchased is a dual fuel type rated at 1080 kilowatts, and drives a synchronous brushless alternating current generator rated at 1000 kilowatts. The exhaust gas from the turbine passes through a heat recovery unit which has a steam capacity rating of 12,500 pounds per hour. The steam from this unit drives a steam turbine which in turn drives a 300 kilowatt induction generator. The initial cost of the above equipment was \$250,000. Cost for installation was \$261,000. (Hancuff-Texas)
W70-07813

EFFECT OF PRIMARY EFFLUENT SUSPENDED SOLIDS AND BOD ON ACTIVATED SLUDGE PRODUCTION,
Grand Rapids Water Pollution Control Plant,
Mich., and Dow Chemical Co., Midland, Mich.
Doris Voshel, and J. G. Sak.
Journal of the Water Pollution Control Federation,
Vol 40, No 5, Part 2, p R203-R212, May 1968. 8
fig, 3 tab, 10 ref.

Descriptors: *Activated sludge, *Biochemical oxygen demand, *Operation, Costs, Sewage treatment, Chlorine, Waste water treatment, Sedimentation.
Identifiers: *Suspended solids, *Concentration, Air supply, Grand Rapids, Michigan, Polymers, Flocculation.

The Grand Rapids Water Pollution Control Plant was constructed in 1929, and consisted of a primary plant only. In 1953 the plant was expanded to include the activated sludge process, and again in 1958 it was further expanded. The primary effluent suspended solids level was observed to have a major influence on the total weight of excess sludge production. The primary effluent suspended solids can be controlled by addition of an organic flocculant to the raw waste water stream. Approximately 1 mg/l of anionic polymer was added to the raw waste water ahead of the grit channel. Little flocculation occurred in the grit channel, but turbulence at the proportional weirs of the channel exit provided excellent mixing. The resulting flocculation removed a greater portion of BOD than is removed normally across the primary clarifier. Additional removal of suspended solids and BOD across the primaries resulted in reduction of extra sludge. Primary effluent suspended solids dropped from 112 mg/l to 45 mg/l. The primary effluent BOD dropped from 77 mg/l to 54 mg/l. Excess activated sludge production was reduced from 34,000 lbs/day to 13,500 lbs/day. Savings in the plant operating costs resulted from reduction of aeration air requirements, decrease in chlorine demand and improved filterability of the sludge. The final effluent quality also improved. (Hancuff-Texas)
W70-07814

DECOMPOSITION OF PYRUVIC ACID,
Bureau of Sewers, Baltimore, Md.
C. E. Keefer, and H. Watkins.
Journal Water Pollution Control Federation, Vol 40, No 5, Part 2, p R230-R234, May 1968. 3 fig, 2 tab, 1 ref.

Descriptors: *Anaerobic conditions, *Degradation (Decomposition), Digestion, Sludge, Methane, Waste water treatment, Sewage treatment.
Identifiers: *Pyruvic acid, *Volatile acid.

The results of three experiments investigating the decomposition of pyruvic acid seeded by digested sludge are shown. In the first experiment pyruvic acid additions amounting to 1.5% of the dry volatile solids in the sludge were made for a period of 28 days. The pH varied from 7.64 to 8.09 volatile acids ranged from 995 to 1407 mg/l, and gas production averaged 513 ml/g of acid added. Methane gas production varied between 40.3 and 48.7%. This was followed by a 7-day period in which acid additions were increased to 3.5% of the dry volatile sludge solids, which in turn was followed by an increase to 5.5%. With the increases in feed there was marked decrease in pH and a marked increase in volatile acids. The same tests were run on two additional sludges. (Hancuff-Tex-as)
W70-07815

MODELING AND OPTIMIZATION OF STEP AERATION WASTE TREATMENT SYSTEMS,
Kansas State Univ., Manhattan.

Larry E. Erickson, Y. S. Ho, and L. T. Fan.
Journal of the Water Pollution Control Federation, Vol 40, No 5, Part 1, p 717-732, May 1968. 6 fig, 2 tab, 5 ref.

Descriptors: *Mathematical models, *Activated sludge, *Kinetics, Optimization, Mixing, Aeration, Sewage treatment, Waste water treatment.
Identifiers: *Step aeration, Growth, Sludge flow, Completely mixed.

Several flow systems for use with the step aeration process have been examined under optimal operating conditions. These systems include several completely mixed tanks in series, several plug flow systems, and a composite system composed of a completely mixed aeration tank and a plug flow aeration tank. After making simplifying assumptions the optimum operating conditions were determined using a discrete version of the maximum principle. The optimization studies show that allocation of feed along the system is desirable under the conditions that are considered in this study. In

other words, the step aeration system is theoretically desirable in some types of operating situations. The study also shows how to determine the optimum allocation and the optimum tank volumes for a given type of step aeration system. When all the systems that were considered are compared, the plug flow system with continuous feed allocation along it minimizes the required volume. The mathematical model used was developed based on certain simplifying assumptions and is considered only an approximation of the complex treatment process. (Hancuff-Texas)
W70-07816

PURIFICATION OF WASTE WATERS FROM THE VISCOSE RAYON INDUSTRY (IN RUSSIAN),

E. A. Kulakov, and I. N. Myasnikov.
Zhurnal Vesesoyuznogo Khimicheskogo Obshchestva IM D.I. Mendelyeva Vol. 12, No. 6 p 638-644, 1967.

Descriptors: *Separation techniques, *Hydrogen sulfide, *Waste water treatment.

Identifiers: *Viscose rayon, Purification, Cellophane, Viscose rayon plant wastes, *Carbon disulfide, *Zinc salts, Suspended solids.

The purification of waste waters obtained from production of continuous filament viscose rayon (900 m. 3/ton), viscose rayon staple (500 m. 3/ton), viscose rayon tire cord (700 m. 3/ton), and cellophane (750 m. 3/ton) is described. Separation processes are suggested for removing all impurities, including acidity 4-8.5 meg./l., pH 2.5-2.8 and CS2 20-100, H2S 5-25, Zn salts 20-75, suspended material 120-470, dry residue 2700-6500, and calcined residue 2200-3500 mg./l. (Livengood - North Carolina State University)
W70-07817

BIOLOGICAL CHEMICAL COMBINATION DRAMATICALLY CUTS TREATMENT COSTS

Ben Davis, and Syd Love.
Water and Pollution Control, Vol 107, No 5, May 1969. p 35-37. 3 fig.

Descriptors: *Biological treatment, *Waste water treatment, *Sewage treatment, *Chemical precipitation, Biodegradation.

Identifiers: Cyanide, Kukland Lake (Ontario).

The community of Kukland Lake, Ontario, produces a high volume of very weak sewage due to excessive infiltration and running of water taps in winter to prevent freezing. In 1965, it was decided to treat this waste and an investigation was initiated. Two hour settling tests yielded 25% BOD removal and 31% SS removal, and showed primary treatment alone would be insufficient. A biodegradability study showed a bulking sludge due to the presence of a toxic substance later identified as cyanide in concentrations of 0.04-0.80 mg/l. In the absence of the cyanide, it was expected contact stabilization would work, but the dilute nature of the sewage would inhibit sludge development. A coagulation study using jar tests resulted in 85% reduction in BOD and suspended solids (SS) at a cost of 2.0-2.5 cents per 1000 gallons. A pilot plant was built and yielded 85% SS removal and 60% BOD reduction with chemical dosages of 8 mg/l lime, 28 mg/l alum and 0.5 mg/l Dow Purifloc A-21, an anionic copolymer. Since BOD removal could not be increased above 60%, a combination chemical-biological pilot plant was tried. With chemical dosages of 20 mg/l alum added directly to the aeration tank Dow A-23 anionic copolymer added to the mixing compartment, a BOD reduction of 83% and SS removal of 90% was achieved. The effluent BOD was consistently less than 24 mg/l. (Makela-Texas)
W70-07818

A PREDICTIVE MODEL FOR THE DESIGN OF FLUID BED ADSORBERS

Michigan Univ., Ann Arbor.
Thomas M. Keinath, and Walter J. Weber, Jr.

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Journal of the Water Pollution Control Federation, Vol. 40, No. 5, p 741-765, May 1968. 14 fig, 1 tab, 29 ref.

Descriptors: *Activated carbon, *Design, *Columns, *Mathematical models, Adsorption, Waste water treatment, Organics, Mass transfer, Diffusion, Reclamation, Reuse, Herbicides, Beds, Depth.
Identifiers: *Fluid bed, Concentration.

A mathematical model describing mass transfer rates for organic pollutants in fluid bed adsorbents is presented. The model has been found to predict adequately the concentration time profiles for systems in which liquid flow rate, particle size of adsorbent, solute concentration, and depth of bed have been varied. Good agreement between experimental data and predicted adsorption behavior is demonstrated. Prediction of the breakthrough curves has been facilitated by measurement of specific adsorption and mass transfer parameters and simple batch-type systems. Because determination of film diffusion controlled mass transfer coefficients is not possible with rapidly agitated batch-type systems, these values have been obtained from generalized correlation of a transfer factor j with the systems specific parametric group (NR/NGA). Conversely, internal diffusion controlled mass transfer coefficients have been determined in non-flow systems and have been shown to be less important than external diffusion control kinetic parameters in determining the overall rate of mass transport. It appears reasonable that the model can be extended to prediction of concentration time profiles for each component of a complex mixture of pollutants. (Hancuff-Texas)

W70-07819

RECOVERY OF CYANIDES BY MODIFIED SERFASS DISTILLATION,

Federal Water Pollution Control Administration, Grosse Ile, Mich.

Charles T. Ely.

Journal of the Water Pollution Control Federation, Vol. 40, No. 5, p 848-856, May 1968. 1 fig, 7 tab, 5 ref.

Descriptors: *Chemical analysis, *Distillation, *Industrial waste, Waste water treatment.
Identifiers: *Cyanides, *Detection, *Determination, Recovery, Serfass distillation.

A significant improvement of simple and complex recovery is developed through a modification of a standard method for determining cyanides. The modified method is effective for measuring cyanide from 0.01 mg/l to higher concentrations of over 1 mg/l. The method is effective for detecting the number of complex cyanides as well as cyanide in domestic and industrial waste water and river water. The proposed method works on nearly all types of samples encountered. The modification which prevents the formation of complex mercuric cyanide ion consists of adding 10 ml of mercuric chloride and 30 mg of magnesium chloride to the standard Serfass method. (Hancuff-Texas)

W70-07820

CONSIDERATIONS IN DIGESTED SLUDGE ELUTRIATION,

Canadian-British Engineering Consultants, Ltd.

T. G. Scott.

Water and Pollution Control, Vol 107, No 10, p 419, October 1969.

Descriptors: *Sludge disposal, *Sludge treatment, *Filtration, Anaerobic digestion, Lime sewage treatment, Waste water treatment.

Identifiers: *Elutriation, Vacuum filtration, Ferric chloride, Spent pickle liquor, North Toronto.

The elutriation process was considered in solving the problem of sewage sludge disposal. The elutriation tank at the North Toronto Sewage Treatment Plant was fitted with a thickener mechanism. Plant effluent was used as elutriation wash water and mixed with the digested sludge in ratios varying

from two to one, to eight to one. Satisfactory filtration was obtained on the vacuum filter using both a chemical dosage of ferric chloride at the rate of 4% by weight of the solids filtered along with 6.5% lime and spent pickle liquor along with 10% lime. A substantial reduction in conditioning chemical demand by the removal of as much as 80% of the digested sludge alkalinity was noted. Problems of filtrate disposal were also eliminated as the filtrate was returned to the elutriation tank. (Galwardi-Texas)

W70-07821

SIMPLIFIED AUTOMATED VOLATILE FATTY ACIDS ANALYSIS,

National Inst. for Water Research, Pretoria (South Africa).

J. E. Harwood, and D. J. Huyser.

Water Research, Vol 2, No 10 p 631-636, October 1968. 2 fig, 1 tab, 3 ref.

Descriptors: *Chemical analysis, Laboratory tests, Anaerobic digestion, *Automation, *Analytical techniques, Waste water treatment, Sewage treatment.

Identifiers: *Volatile fatty acids, *Manifold design, Pretoria, South Africa.

A method is proposed for the automated determination of the total volatile fatty acid content of aqueous samples. The manifold used in the proposed method is simpler and the method quicker than existing procedures. The long mixing coils used for mixing two reagent streams before addition to the sample streams are omitted. A flow diagram of the manifold is presented. Sampling speeds have been increased from 10 to 15 samples/hr to 30 to 40 samples/hr at a 1:2 sample/wash ratio. A steadier base-line is obtained using the simplified manifold. No special preparation of the reagents is required. Accuracy is improved by introducing the determination of a sample blank, which makes allowances for any natural color introduced by the sample itself. A comparison of manual and automatic analyses with and without blank correction is presented. (Galwardi-Texas)

W70-07822

SOILS SYSTEMS FOR LIQUID WASTE TREATMENT AND DISPOSAL: ENVIRONMENTAL FACTORS,

Robert A. Taft Water Research Center, Cincinnati, Ohio.

Warren A. Schwartz, and Thomas W. Bendixen.

Journal of the Water Pollution Control Federation, Vol. 42, No. 4, p 624-630, April 1970. 8 tab, 4 ref.

Descriptors: *Liquid wastes, *Groundwater, Waste water treatment, Biological treatment, Disposal, Chemical oxygen demand, Temperature, Depth, Vegetation, Lysimeters.

Identifiers: *Soil systems.

A study of the interaction of environmental factors with design factors such as dosing frequency, and waste pre-treatment is an essential prerequisite for the establishment of design principles for soil systems. A number of environmental factors were investigated for their effect on the treatment potential and hydraulics of soil systems. The parameters used for this investigation were chemical oxygen demand, MBAS, ammonia-nitrogen, and hydraulic longevity. The controlling factor for hydraulic longevity and treatment efficiency was the effect of depth in shallow systems, 2 to 4 feet. It is reported that this is probably due to the limited reaeration opportunity in the unsaturated zone. The effects of climate on removal efficiency are also studied. The tables are given presenting the effect of unsaturated depth on performance, interaction between climate and pre-treatment, interaction between climate and dosing frequency, and effect of vegetation on performance. In studying the climatological effects, the mean daily temperature in winter was 33 deg. F and in summer was 73 deg. F. Summer longevities were uniformly three times the winter longevities. It should be noted that the early days of operation are critical for the rate of biological

development and extended longevities. The unit started in summer ran through the following winter without any difficulty. (Hancuff-Texas)

W70-07823

TRAINING AND CERTIFICATION OF WASTE WATER OPERATORS IN TEXAS,

Huppert (Jack) Co., Inc., San Antonio, Tex.

Jack E. Huppert.

Journal of the Water Pollution Control Federation, Vol. 42, No. 4, p 641-644, April 1970. 1 tab.

Descriptors: *Training, *Education, Sewage treatment, Waste water treatment, Operations, Permits, Licenses.

Identifiers: *Certification, Responsibility, Licenses, Texas.

The history of the development of certification in the State of Texas is presented. The program began on a voluntary basis in 1939 and was so well accepted that by 1945 certification became mandatory without opposition. Almost 600 certificates were issued under the voluntary plan and were 'grandfathered' when the mandatory law was passed. Cooperation between state agencies, operator groups, universities, and municipal officials has been the key to success of the program for training and certifying operators. An annual short school is held each year on the campus of Texas A and M University. The school extends over a period of 5 days with one half of the time devoted to water works instruction and one half to waste water instruction. The Texas Water Utilities Association encompasses 40 district associations and has a total membership of approximately 40,500. Monthly meetings are held and attended by operators within the areas. Programs consist of round table discussions, education films, or lectures from visiting or local speakers. In addition to the monthly meetings some district associations within the region join together to sponsor a 3 day short school. The region schools are designed to provide for those who can not attend the annual short school at Texas A and M. A list of the various qualifications for certification of grades A through D is tabulated. A one and two year water and waste water technology course is conducted at James Connally Technical Institute in Waco. (Hancuff-Texas)

W70-07824

FILTRATION TECHNIQUES IN TERTIARY TREATMENT,

Stanford Univ., Calif.

George Tchobanoglou.

Journal of the Water Pollution Control Federation, Vol 42, No 4, p 604-623, April 1970. 15 fig, 8 tab, 18 ref.

Descriptors: *Filtration, *Tertiary treatment, *Performance, *Headloss, Sewage treatment, Waste water treatment, Activated sludge, Pilot plant, Turbidity, Mathematical model, Design, Operations research.

Identifiers: *Removal mechanisms, Polyelectrolytes, Suspended solids.

A thorough investigation of filtration techniques used for treating settled secondary effluent is described. The removal efficiency for filtration without the addition of chemicals is primarily a function of grain size. Typical removal efficiencies using conventional single medium sand or anthracite filter beds with depths of 18 to 30 inches varied depending upon the grain size from 10 to 60%. In the filtration of settled effluent with and without the addition of chemicals turbidity breakthroughs were not observed within the headloss range studied, 8 to 10 feet. As presently designed the sand layer in most dual medium filter beds is not utilized effectively. In multi-media filter bed if the anthracite layer is greater than 16 to 20 inches media placed below the anthracite contributes little to the overall suspended solids removal. Polyelectrolytes can be used as an additive to achieve varying degrees of suspended solids removal from secondary effluents using single, dual and multi-media filter beds. The distribution of

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suspended solids within the filter can be controlled by varying the amount and point of addition of polyelectrolytes. The grain sizes utilized in this study varied from 0.49 mm to 0.98 mm and loadings varied from 2.0 gal/min/sq ft. to 10.0 gal/min/sq ft. For studying the suspended solids removal the polyelectrolyte dosage varied from 20 to 40 mg/l, while the electrophoretic mobility was measured varying polyelectrolyte dosage from 0 to 50 mg/l. (Hancuff-Texas)
W70-07825

TOXICOLOGICAL ASPECTS OF WASTE WATER RECLAMATION—A PRELIMINARY REPORT.

California State Dept. of Public Health, Berkeley.
Alice Ottoboni, and Arnold E. Greenberg.
Journal of the Water Pollution Control Federation, Vol 42, No 4, p 493-499, April, 1970. 2 fig, 2 tab, 18 ref.

Descriptors: *Water reuse, *Tertiary treatment, *Laboratory animals, Waste water treatment, Rodents, Growth rates, Activated sludge, Diseases. Identifiers: *Rats, *Toxic diseases, Tumors, Activity, Toxicology.

Research on the toxicity of domestic waste water to rats was conducted for a period of 18 weeks. Domestic waste water, unchlorinated activated sludge plant effluent, was provided as the sole water source to a group of young rats, and the same community's potable water supply was given to a second, or control group. In this preliminary investigation of possible adverse effects of waste water fed to rats it was observed that: (1) Male rats given waste water ad libitum gained more weight than control rats, on the average 15% heavier. (2) Females given water had significantly smaller adrenal glands than control females, on the average 20% lighter. (3) Two male rats developed massive tumors not previously seen in this rat strain at such a young age. Possible causes for these differences and their significance are discussed. Trace organics may be involved; until additional studies are completed, a tentative evaluation is impossible. (Hancuff-Texas)
W70-07826

SURVEY OF WASTE WATER TREATMENT PLANT OPERATOR CERTIFICATION IN THE U.S.

Water Pollution Control Federation, Washington, D.C. Personnel Advancement Committee.

Journal of the Water Pollution Control Federation, Vol 42, No 4, p 511-517, April 1970. 4 tab.

Descriptors: *Waste water treatment, *Training, Education, Classification, Surveys, Permits. Identifiers: *Operators, *Certification, Licenses.

At the end of 1968, 21 states had mandatory programs, 26 states had voluntary programs, and 3 states had no programs. To date, two more states have adopted mandatory certification. Approximately 21,000 operators have been certified prior to 1969. The states have identified 60,551 waste water facilities as having certified operators. The survey shows that approximately 21% of those facilities requiring certified operators did not have certified operators and therefore may not have operating personnel meeting prescribed qualifications. The survey clearly indicates a need for additional persons who meet qualifications for employment in water pollution control plants. The data which were obtained and are tabulated presents the sponsoring or administering agency, experience levels, academic requirements, job functions covered by certification programs, and employing organizations. (Hancuff-Texas)
W70-07827

LIGNOSULFONATES IN PETROLEUM FERMENTATION,

British Columbia Univ., Vancouver.

D. L. Liu, and P. M. Townsley.

Journal of the Water Pollution Control Federation, Vol 42, No 4, p 531-537, April 1970. 9 fig, 2 tab, 2 ref.

Descriptors: *Fermentation, *Growth rates, Respiration, Microorganisms, Bacteria, Pulp wastes, Surfactants.

Identifiers: *Petroleum, *Lignosulfonate, Culture media, Kerosene, Vancouver (British Columbia).

The addition of polymerized lignosulfonates into hydrocarbon fermentation media greatly increases the fermentation rate and the yield of biomass. Lignin itself does not appear to decompose during the fermentation; however, immediately upon the addition and vigorous mixing a stable oil water medium emulsion is formed. This emulsion increases the hydrocarbon water interfacial area, thus overcoming the major factor limiting microbial activity. The removal of hydrocarbon as a growth limiting factor in fermentation greatly reduces the requirement for oil dispersion equipment. The effects of the addition of a commercial grade lignin and a surface active agent on acid production, oxygen uptake rate and cell yield are determined on cultures isolated by the kerosene enrichment procedure. The oxygen uptake rate as a function of the carbon chain length in the basic medium was determined. C7 to C11 showed significant increase in dry cell weight in the presence of commercial lignin. A comparison of the dry cell yield and the acid production as a function of kerosene concentrations also is determined. This study indicates that lignosulfonates may be an inexpensive ingredient in water and pollution control fermentations. (Hancuff-Texas)
W70-07828

STOP-GO DIGESTERS AT READING,

R. L. Summers, J. F. Marshall, and S. D. Wood.
Water Pollution Control, Vol 69, No 2, p 149-158, March-April 1970. 7 fig, 5 tab, 4 ref.

Descriptors: *Anaerobic digestion, *Toxicity, *Ammonia, Performance, Laboratory tests, Detergents.

Identifiers: *Anionic detergent, *Loading rates, Failure, Concentrations, Reading (England).

The conventional control parameters of anaerobic digestion gave no advance warning of a series of failures which were described. An empirical anaerobic 'activity' test in which digester samples were slug fed and hourly gas production rates recorded was proposed as a means of indicating environmental change and consequently could give an early indication of impending failure. Laboratory studies were conducted to investigate the toxicity of ammonia nitrogen and anionic detergent concentration on anaerobic digestion. Results showed severe suppression at an ammonia nitrogen concentration of 1500 mg/l with the anionic detergent level held at 2% of dry solids, and an ammonia nitrogen concentration of 1050 mg/l and anionic detergent as 2.4% of the dry solids. A related study of high loading rates is presented. Results from laboratory digesters showed that the loading rate could be increased from 0.1 lb volatile matter/cu ft-day to 0.3 lb volatile matter/cu ft-day. (Galwardi-Texas)
W70-07829

WATER MANAGEMENT SAVES MONEY,

C. R. Kolzow.
Water and Sewage Works, Vol 116, No 5, May 1969. p 6-7, 3 tab.

Descriptors: *Metals, *Industrial wastes, *Industrial water, *Water reuse, *Water users, Chromium, Water pollution control.

Identifiers: *Metal finishing industry, Zinc cyanide.

Water use in the U.S. increased from 40 bpd in 1900 to 320 bpd in 1960 and is expected to increase to 600 bpd by 1980. By reuse and recirculation, the total water requirement of industry can be reduced. 80% of total water is used in irrigation and 94% of this volume is consumed by plant growth or

evaporation. Industry consumes only 8% of the water it uses. In-plant control of industrial wastes should be investigated. Every industry can reduce their primary water needs by process improvement, water conservation, and water reuse. Where cooling is the principle use, substitution of recycle for once through can reduce water intake by as much as 90%. Savings of \$40,000 per year in a metal finishing plant were recognized as a result of installation of counter-current rinsing, chrome recovery, plating salt recovery, demineralized water recovery, zinc cyanide recovery, and temperature regulation. (Makela-Texas)
W70-07830

SEWAGE WORKS MAINTENANCE,

W. E. Oliver, B. J. Vousden, and E. G. Eves.
Water Pollution Control, Vol 69, No 2, p 166-169, March-April 1970.

Descriptors: *Maintenance, *Facilities, *Sewage treatment, *Labor, Management, Waste water treatment.

Identifiers: *Preventive maintenance, *Communicators.

The method of preventive maintenance which evolved at the sewage treatment plant at the London Borough of Sutton is described. The basic concepts presented can be used as a foundation for almost any sewage plant. Equipment breakdown, and subsequent shut-down of plant operation can be avoided by a proper program of well planned preventive maintenance. All operating machinery should be lubricated regularly and inspected for defects in equipment or operation. Defects should be registered by a Defect Report, and Maintenance Reports should also be required. Certain commonly used spare parts should be stockpiled. Standardization of equipment is recommended both from the viewpoint of interchangeability of parts and decreased requirements for stockpiled parts not neglecting the increased familiarity of maintenance personnel working on only one line of equipment. Painting increases the life of equipment. The use of three coats of different color helps in inspection to see the coats are properly applied. Buildings, roads, and grounds need less frequent maintenance. (Makela-Texas)
W70-07831

ENUMERATION STUDIES ON METHANOGENIC BACTERIA,

National Inst. for Water Research, Pretoria (South Africa).

M. L. Siebert, D. F. Toerien, and W. H. J. Hattingh.
Water Research, Vol 2, No 9, September 1968, p 545-554. 5 tab, 2 ref.

Descriptors: *Anaerobic bacteria, *Methane bacteria, *Statistical methods, Carbon dioxide, Hydrogen, Vitamins.

Identifiers: *Media, Mineral salts, Fatty acids, Digester fluids, Rumen fluids, Acetate, Formate, Glucose, Colony counts.

A statistical comparison of various media for the enumeration of methanogenic bacteria was performed. A digester receiving a synthetic substrate was used as a source of inocula during these studies. Two experiments were carried out. In the first experiment eight treatments with five replications of each treatment, and in the second experiment twenty-two treatments with five replicates of each treatment were compared. A reduced medium containing mineral salts, vitamins, small amounts of fatty acids, carbon dioxide (22%) and hydrogen (78%) should be used for the enumeration of methanogenic bacteria. The addition of rumen fluid and digester fluids to the media seemed to have stimulated the growth of more colonies, some of which may have been non-methanogenic in origin. Additions of formate, acetate and glucose resulted in repressed bacterial counts in certain circumstances. (Galwardi-Texas)
W70-07832

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

ADVANCED TREATMENT OF PETROLEUM WASTE WATER BY AUTOXIDATION,

Prather and Prather, Tulsa, Okla.

B. Vail Prather.

Journal of the Water Pollution Control Federation, Vol 42, No 4, p 596-603, April 1970. 1 fig, 3 tab, 12 ref.

Descriptors: *Industrial waste, *Aeration, *Tertiary treatment, Waste water treatment, Chemical oxygen demand, Biochemical oxygen demand, Oil.

Identifiers: *Autoxidation, Refinery waste, Chemical oxidation, Aeration tower, Free radical.

Residual dissolved organic contaminants are harbingers of trouble in industrial water systems and must be reduced to a minimum before the waste water can be reused successfully. Methods of removal of these organic residuals generally fall into three classes: (1) Biological degradation, (2) Chemical oxidation, (3) Physical stripping. A chemical oxidation process which utilizes autoxidation reactions is described. The process takes advantage of stripping and cooling action as well as oxidation. A series of chain reactions in the autoxidation system are presented. The role in initiators in the formation of free radicals is discussed. Aeration techniques in design of an aeration tower are presented. The influence of biological activity on reduction of chemical oxygen demand was evaluated with the conclusion that chemical oxidation existed independently of biological oxidation. The results of this study indicated that the oxidation-aeration tower offers an economical method for removal of small organic residuals by autoxidation, and stripping of ammonia and other unwanted gases at about the same cost as that of cooling the water. The aeration tower used for these studies has a height of 25 feet, a width of 4 feet, and a depth of 6 feet. The volume of water charged to the tower which gave the best results was 25 gal/min/sq ft. and an air flow of 7600 cfm. Residence time for water flowing through the tower was estimated at 3 to 6 minutes. (Hancuff-Texas)

W70-07833

METAL-FINISHING WASTES CAN BECOME POTABLE WASTES,

Leeds and Northrup Co., North Wales, Pa.

F. C. Snowden.

Water and Sewage Wastes, Vol 116, No 5, p 9-11, May 1969. 4 fig, 2 tab.

Descriptors: *Industrial wastes, Copper, *Chromium, *Treatment facilities, Hydrogen ion concentration, Chemical reactions, Industrial waste, Waste water treatment, Oxidation, Reduction, Potential.

Identifiers: *Metal finishing, North Wales (Pa), *Cyanides, *Nickel.

A description of the waste treatment facility for Leeds and Northrup Company metal-finishing plant is presented. The major pollutants in the waste include cyanides, chromates, copper and nickel. At various times the effluent either highly alkaline or acidic. The waste treatment facility is a Lancy Laboratories, Inc. design and is basically a series of processes, each designed to neutralize a particular contaminant. Each process is equipped with its own set of pH and/or ORP controls. A conductivity monitor checks steam condensate from the heating coils in the plating solutions. The treatment system provides for the removal of cyanide, nickel, chromium and copper in addition to neutralization of the waste. Equilibrium equations used in the design of each system were presented along with an average analysis of the waste stream after treatment. (Galwardi-Texas)

W70-07834

WATER REUSE IN INDUSTRY,

Engineering-Science, Inc./Texas, Austin.

E. F. Glynna, D. L. Ford, and J. Eller.

Journal of the Water Pollution Control Federation, Vol 42, No 2, p 237-242, Feb 1970. 8 fig, 2 tab.

Descriptors: *Waste water treatment, *Oil industry, *Water reuse, *Industrial wastes, *Cooling towers, Cation exchange.

Identifiers: *Refineries, *Storm water runoff, *Collection system, Boiler blowdown.

A system designed to treat liquid wastes from oil refineries and produce a salable product is described. About 40 million gallons of spent phenolic caustic wastes and 20 million gallons of spent sulfide caustic wastes are shipped to the treatment plant. Known pollutants in the waste material include phenols, cresols, cresylic acid, mercaptans, sulfides, thiophenols, caustic soda, and heavy metals. The finished products are cresylic acid and sodium sulfide solutions. The waste water collection system consists of a comprehensive network of drip-pans, collection troughs, dikes, and tanks. This network is interconnected to the process system and cooling towers. The cooling towers are used to reduce the concentration of organics and to concentrate the undesirable precipitates. High concentrations of heavy metals are reported in the cooling tower sludge and total carbon in the settled sludge and filtrate, respectively, is about 200,000 mg/l and 50,000 mg/l. The first half inch of rainfall is diverted to tankage, the second half inch is sent to storage for ultimate use as cooling tower makeup water, and any uncontaminated excess storm water overflow is released to a nearby water course. Cation exchangers are used to treat blowdown from the boilers. (Galwardi-Texas)

W70-07835

DETECTION OF INDUSTRIAL WASTES IN MUNICIPAL SYSTEMS,

San Diego Water Quality Control Board, Calif.

Ladin H. Delaney.

Journal of the Water Pollution Control Federation, Vol 42, No 4, p 645-648, April 1970.

Descriptors: *Industrial waste, *Sewage treatment, *Sampling, Waste water treatment, Activated sludge, Digestion, Maintenance, Odor.

Identifiers: *Detection, *Surveillance, Collection systems.

Because of the wide range and infinite variety of industrial wastes it is almost physically impossible to install automatic sampling and analytical equipment that will do an adequate job of detecting all industrial wastes in a non-homogenous waste water flow such as municipal waste. It is necessary for operating and maintenance personnel to represent the first line of attack for industrial waste detection. A most important indication that an industrial waste is being discharged to the system is a change in color. Many industries impart a characteristic color to the waste water. Copper sulfate is blue, chromium is green, milk waste is white, slaughter house waste is red. Odors also can be an important indicator. Solvents and many other chemicals have peculiar smells which will impart a different odor to the waste water. Temperature sometimes is an indication that thermal wastes are being discharged. Excessive amounts of water vapor rising from the influent stream should be investigated. Many times visual olfactory signs are not manifested and it becomes necessary to observe the side effects on the system itself. Corrosion is an excellent example. Other side effects are activated sludge and digester upsets. An example is cited in which an increase in sludge production was found to indicate a potential overload of the digester system. (Hancuff-Texas)

W70-07836

NTA REMOVAL BY ACTIVATED SLUDGE—FIELD STUDY,

Ohio State Univ., Columbus; and Proctor and Gamble Co., Cincinnati, Ohio.

K. S. Shumate, J. E. Thompson, J. D. Brookhart, and C. L. Dean.

Journal of the Water Pollution Control Federation, Vol 42, No 4, p 631-640, April 1970. 5 fig, 3 tab, 6 ref.

Descriptors: *Activated sludge, *Degradation (Decomposition), Removal, Operations, Waste water treatment, Sewage treatment, Detergents, Surfactants.

Identifiers: *Trisodium nitrilotriacetate.

A one MGD conventional activated sludge treatment plant was used for the study of trisodium nitrilotriacetate (NTA) degradation. The NTA was fed at a maximum expected level of 8 mg/l and was 90% removed by the activated sludge treatment. At a higher level, 16 mg/l, removal varied widely but averaged 75%. At no time did the addition of NTA have any effect on plant performance and degradation of NTA continued in the receiving stream and was probably essentially complete within two miles downstream. The data presented indicated that there is a very slight removal of NTA in the primary tanks amounting to an average of about 8% for the entire duration of the study. Variability of NTA removal increased with increasing NTA dosage, resulting in a significant decrease in average removal. (Hancuff-Texas)

W70-07837

ALGAL PERIODICITY AND WASTE RECLAMATION IN A STABILIZATION POND ECOSYSTEM,

Iowa State Univ., Ames.

Ronald L. Raschke.

Journal of the Water Pollution Control Federation, Vol 42, No 4, p 518-530, April 1970. 2 fig, 6 tab, 40 ref.

Descriptors: *Waste water treatment, *Ponds, *Algae, Lagoons, Biochemical oxygen demand, Chemical oxygen demand, Phosphates, Nitrogen, Stabilization.

Identifiers: *Water reclamation, Variations, Composition.

In an attempt to evaluate possible procedures for meeting new standards of the Federal Water Quality Act, the Ames Water Pollution Control Department built a number of experimental ponds. One of them was made available for the present investigation in which the intent has been to study algal composition and periodicity, dissolved oxygen, pH, temperature, and the extent of reduction in 5-day BOD, COD, solids, phosphates, ammonia, and nitrates through the plant pond complex. The pond is 0.12 acre in area with a water holding capacity of 105,562 gallons and an average depth of 2.53 feet. The pond detention time ranged between 3.7 to 4.2 days. Results showed that algal periodicity and BOD analysis may be influenced by algal inhibitors. Green flagellates dominated in winter and spring, while coccoid greens dominated in summer and fall. The maximum per cent removal at any one time was 78% and 75% for BOD and filtered BOD respectively. The maximum COD removal was 63%. Total suspended solids ranged from 458 to 687 which is less than a limit of 1000 mg/l set by the U.S. Public Health Service Standards. Ammonia nitrogen ranged from 0.0 to 21.0 mg/l and nitrate nitrogen ranged from 0.5 to 1.8 mg/l. pH ranged from 7.35 to 9.09 and temperature from 0.8 deg C to 29.9 deg C. The effluent usually met the Iowa Water Pollution Control Commission's standards for temperature, pH, dissolved oxygen concentration, but phosphorus and nitrogen contents were high. (Hancuff-Texas)

W70-07838

MICROBIOLOGY OF DOMESTIC WASTES, I. PHYSIOLOGICAL ACTIVITY OF BACTERIA INDIGENOUS TO LAGOON OPERATION AS A FUNCTION OF SEASONAL CHANGE,

Manitoba Univ., Winnipeg.

Harvest Halvorson, M. Ishaque, and H. Lees.

Canadian Journal of Microbiology, Vol 14, No 4, p 369-376, Apr 1968. 6 fig, 20 ref.

Descriptors: *Bacteria, *Domestic wastes, *Lagoons, Microbiology, Waste water treatment.

Identifiers: *Physiological activity.

Waste Treatment Processes—Group 5D

The physiological activity of bacteria indigenous to a midcontinental domestic waste disposal unit (lagoon) was studied over a period extending from mid-May to the beginning of December 1965. A rigorous climate induces a layer of ice over the lagoon for approximately 5 months of the year; this study entailed the interval under ice-free conditions during the first year of operation. Samples were collected roughly at weekly intervals and the activity of the bacteria free of algae was studied against several arbitrarily selected organic substrates. The activity was found to be a function of (a) the number of bacteria, (b) the temperature of the lagoon, and (c) the nature of the best substrate. The most rapid rates of oxidation occurred with casamino acids, acetate, and palmitate. Glucose, egg albumin, and liqui-nox, a biodegradable detergent were oxidized in a variable manner. Maximum activity occurred at 23 deg C, the highest temperature reached by the lagoon during the summer. The rates of oxidation decreased as a result of the onset of fall but all activities were not affected equally by the same temperature change. (Aguirre-Texas)
W70-07948

MICROBIOLOGY OF DOMESTIC WASTES. II. A COMPARATIVE STUDY OF THE SEASONAL PHYSIOLOGICAL ACTIVITY OF BACTERIA INDIGENOUS TO A SEWAGE LAGOON,
Manitoba Univ., Winnipeg.
Harvest Halvorson, M. Ishaque, and H. Lees.
Canadian Journal of Microbiology, Vol 15, No 6, p 563-569, June 1969. 2 fig, 35 ref.

Descriptors: *Metabolism, *Sewage lagoons, *Temperature, Bacteria, Domestic wastes, Microbiology, Waste water treatment.
Identifiers: *Physiological activity.

A comparative study was made of the physiological activity of bacteria seasonally present in a sewage lagoon which experiences warm summers and very cold winters. Bacteria recovered from surface samples of lagoon water during summer were able to metabolize glucose, acetate, palmitate, creatinine, vitamin-free casamino acids, egg albumin, and urea aerobically at 25 deg C, the highest prevailing temperature during the summer. Under anaerobic conditions, acetate and palmitate were the only substrates not metabolized. Bacteria recovered from samples of lagoon water taken during winter were able to metabolize aerobically glucose, acetate, palmitate, creatinine, and urea at 2 deg C, the prevailing temperature under ice cover, but casamino acids and egg albumin were not metabolized aerobically at 2 deg C or 25 deg C. Acetate, palmitate, casamino acids, and egg albumin were not metabolized anaerobically by bacteria in winter samples. Urea was hydrolyzed much more rapidly by bacteria in the winter samples and is probably the preferred nitrogen source for growth under winter conditions. The optimum pH for oxidation of acetate and casamino acids by bacteria in summer samples was 7.0; only 50% of the maximum activity was obtained at pH 9.0, virtually the highest pH that was found under natural conditions. Bacteria active at low temperatures contribute appreciably to the stabilization of domestic wastes by the lagooning method even under severe winter conditions. (Aguirre-Texas)
W70-07949

A CHARACTERIZATION OF TUNA PACKING WASTE,
Hawaii Univ., Honolulu.
Michael J. Chun, Reginald H. F. Young, and
Nathan C. Burbank, Jr.
Proceedings of the Industrial Waste Conference,
23rd, p 786-805, May 1968. 10 fig, 6 tab, 10 ref.

Descriptors: *Biodegradation, *Biochemical oxygen demand, *Biological treatment, *Fish, *Wastes, Nutrients, Toxicity.
Identifiers: *Characterization, *Treatability, *Tuna packing wastes.

The characterization of a tuna cannery waste revealed a pH, temperature and dissolved oxygen content suitable for biological treatment. The total solids content of the tuna packing waste was 17,900 mg/l of which 37% was organic matter. Biodegradation of the tuna waste was limited as indicated by a COD/BOD ratio of 0.4. Treatability studies conducted on the waste gave an average daily COD range from 1300 to 3250 mg/l and an average daily BOD₅ range from 500 to 1550 mg/l. Excess nutrient material was present in the form of phosphorus and nitrogen with a BOD₅/N/P ratio of 100/68/7. The tuna waste alone was not conducive to aerobic biological treatment due to some inhibitory or toxic reaction. Dilution with domestic sewage in a ratio of 4/1 resulted in a material that was treated to about 60% of the theoretical oxygen demand. Long-term BOD studies indicated that the nitrogenous oxygen demand was about 40% of the total demand. (Aguirre-Texas)
W70-07951

POLLUTION ABATEMENT TECHNOLOGY DEGREE OFFERED.

Charles County Community Coll., La Plata, Md.
Dept. of Biology.

Water and Sewage Works, Vol 116, No 1, p 20-22, January 1969.

Descriptors: *Education, *Training, *Waste treatment, *Waste water treatment, Treatment facilities, Operation and maintenance.
Identifiers: Treatment plant operators.

In 1966, Charles County Community College began a project, the primary goal being the training of technical manpower in the fields of water pollution and waste management. An Associate of Arts degree will be awarded to graduates of the two-year, one summer curriculum which covers the background, theory, and technical training in each subject area. Facilities include a new building with classrooms and laboratories, and a functional waste treatment plant serving both the college and the community. Career opportunities are expected to be unlimited and may include such positions as treatment plant supervisor, field technician, laboratory technician, and industrial waste technician. A listing of the proposed curriculum is included. (Makela-Texas)
W70-07952

FISH OIL AND PROTEIN RECOVERED FROM FISH PROCESSING EFFLUENT,

Kurita Water Industries Ltd., Yokohama (Japan); and Hayashikane Sangyo Co., Ltd., Shimonoeski (Japan).

Kenji Kato, and Shizuhiko Ishikawa.
Water and Sewage Works, Vol 116, No 10, p 412-416, October 1969. 5 fig, 6 tab, 1 ref.

Descriptors: *Industrial wastes, *Waste water treatment, *Fish, *Proteins, Fish handling facilities.
Identifiers: *Fish oil, *Product recovery.

Fish oil and protein are recovered as a valuable byproduct in the treatment of an effluent from a fish processing plant in Shimonoeski, Japan. Fish meat from horse mackerel, scabbard fish, and yellow croaker is first machined to remove head and guts, and then is separated from the bones to make a chop, with a yield of 60-65% by weight. Water is added to form a slurry. The slurry is put through a gravity settling unit and oil is removed by skimming. Meat solids are centrifuged to form a primary product. The effluent produced then passes into another unit where oil is removed by gravitational flotation. The oil is heated to 90 deg C to coagulate protein mixed in with the oil and the mixture is centrifuged to remove the protein. The underflow from the oil separator is sent to coagulation tanks where HCl is added to lower the pH from 6.0-7.0 to 5.0-5.5, and a coagulant aid is added. The coagulated protein is then subjected to pressurized floatation for 30 minutes. The protein is

removed by skimmers and is vacuum filtered. Recovered protein brings 0.6 cents/lb based on 82% moisture content. Recovered oil brings 3.5 cents/lb. A total of 25 tons of protein and 1.6 tons of oil are recovered daily from 1,170 tons of raw effluent. Suspended solids were reduced 86%, and BOD was reduced 77%. (Makela-Texas)
W70-07953

NEW FLOTATION AIR FOR PAPER MILL WHITE WATER SYSTEM,

Proctor and Gamble Co., Cincinnati, Ohio.
D. J. Hahn, J. J. Jende, T. F. Rich, and F. J. Tremel.
Water and Sewage Works, Vol 116, No 8, p 321-324, August 1969. 5 fig, 1 tab, 2 ref.

Descriptors: *Industrial wastes, *Flotation, Waste water treatment, Laboratory tests, Pilot plants, Performance, *Pulp wastes, Pulp and paper industry.
Identifiers: *Suspended solids, *Coagulant, *Cationic, *Guar gum, Full-scale unit, Concentration.

The establishment of new and more stringent suspended solids discharge allowances, required the improvement of the white water flotation process. Approximately fifty different chemicals were evaluated by the Charmen Paper Products Company for flotation improvement. Based upon the laboratory results, six chemicals were selected for further study in a pilot flotation unit. A modified cationic guar gum coagulant yielded the best results. The effluent suspended solids concentration dropped to less than 10 mg/l and the solids being scraped off the unit became noticeably more compact and thicker. Tests on full-scale units showed that the effluent suspended solids dropped from over 120 mg/l to less than 36 mg/l with an addition of about 2 mg/l of the chemical. (Galward-Texas)
W70-07954

WATER CONSERVATION REDUCES LOAD ON SOHIO'S WASTE TREATMENT PLANT,
Sohio Refinery, Lima, Ohio.

B. A. Rose.
Water and Sewage Works, Vol 116, No 9, p 4-8, September 1969. 3 fig.

Descriptors: *Industrial wastes, *Industrial water, *Oil, *Waste water treatment, *Water reuse, *Waste water disposal, *Oily water, Oil industry.
Identifiers: Oil-water separator.

The Sohio refinery at Lima, Ohio, on the Ottawa River currently processes 55,000 barrels of crude oil per day. This refinery burns about one billion BTU/hr in its furnaces, and requires 40,000 gpm of water for cooling purposes, if the water is used once, and picks up 30 deg F. Groundwater makes up the source of supply. Cooling towers permit recirculation of 40,000 gpm of water for cooling and condensing operations. Make up waters include 3000 gpm of well water to replace water lost by evaporation, physical loss, and the 1800 gpm of cooling tower blowdown. Smaller quantities of process waste waters also contribute to the plants waste stream. Recirculation of cooling waters conserves water, reduces the volume of waste water to be treated, and minimizes loss of pollutants. Sodium hydroxide solutions used in several treatment operations are regenerated for reuse or sold. Separate sewer systems allow recovery and reuse of lost chemicals. Water used in the high pressure hydraulic coke cutter is recycled to prevent contamination of oily waters with fines which might stabilize oil-water emulsions. Sulfides are removed in steam strippers, and phenolic waters are used as makeup in the crude oil desalting process. In spite of all closed sewer systems and conservation procedures, 2500 gpm of waste water are produced and need to be treated. Primary treatment occurs in an API oil-water separator, which recovers more than 300 barrels of oil per day. (Makela-Texas)
W70-07955

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

POULTRY PROCESSOR MEETS CHALLENGE OF INCREASED WASTE LOAD, Gold Kist Poultry, Atlanta, Ga.

William J. Camp.

Water and Sewage Works, Vol 116, No 9, p 24-26, September 1969.

Descriptors: *Design criteria, *Industrial wastes, *Poultry, Waste water treatment, Biochemical oxygen demand (BOD), Performance, Farm wastes, Florida.

Identifiers: *Extended aeration, *Suspended solids, Live Oak (Fla).

Design criteria and operating results of an extended aeration treatment system for a complete poultry processing plant are presented. The processing plant is designed to handle 50,000 birds per day utilizing 10 gal of water per bird and have an organic load of 52 lb BOD per 1000 birds. The treatment system consists of a by-products collector tank, 80-minute detention time; two extended aeration tanks, 24-hour detention time; final settling tank, 2-hour detention time; aerobic digester; polishing pond; chlorination system; and two sludge drying beds. Operating results obtained indicate a water usage of about 7.6 gal per bird, with a BOD loading of about 39 lb per 1000 birds. Effluent from the final clarifier shows a 99% BOD removal with an average of 8 mg/l BOD and 98% suspended solids removal with an average of 10 mg/l. The effluent from the polishing pond averages 3 mg/l BOD with a dissolved oxygen average of about 8.0 mg/l. (Galwardi-Texas)

W70-07956

EFFECTS OF NITROGEN LIMITATION ON THE GROWTH AND COMPOSITION OF UNICELLULAR ALGAE IN CONTINUOUS CULTURE,

School of Aerospace Medicine, Brooks AFB, Tex. B. Richardson, D. M. Orcutt, H. A. Schwertner, Cara L. Martinez, and Hazel E. Wickline.

Applied Microbiology, Vol 18, No 2, p 245-250, August 1969, 3 fig, 4 tab, 19 ref.

Descriptors: *Growth, *Algae, Lipids, Nutrients, Chlorella, Cultures.

Identifiers: *Fat accumulation, *Laboratory studies, *Nitrogen limitation, Batch cultures, Chlorella sorokiniana, Composition of algae, Continuous cultures, Fatty acids, Oocystis polymorpha, Unicellular algae.

Fat accumulation takes place in many algae as a response to exhaustion of the nitrogen supply and may provide a means of enhancing the potential food value of algae. Chemostatic continuous cultures of Chlorella sorokiniana and Oocystis polymorpha were subjected to successive reductions in influent nitrogen. As cellular nitrogen content decreased from about 10 to 4%, oxygen evolution, carbon dioxide uptake, chlorophyll content, and tissue production were drastically reduced, but total lipid content was essentially unchanged. In batch-cultured cells, nitrogen could be reduced to 3% of dry weight, causing an increase in total fatty acids and pronounced changes in the composition of the fatty acid fraction. These results suggest that cellular nitrogen must fall to about 3% of dry weight before appreciable increases in lipid synthesis can occur. All nitrogen is then apparently completely bound in essential cell constituents, and carbon subsequently fixed is converted into lipid products. Nitrogen limitation may be useful in increasing the food quality of batch-cultured cells, but the technique has little value for continuous culture systems *per se*. (Aguirre-Texas)

W70-07957

WATER AND EFFLUENTS, Society of Dyers and Colourists, London (England).

R. W. Moncrieff.

Textile Manufacturer, Vol 93, p 11-13, 1967.

Descriptors: *Effluents, *Surfactants, Waste water treatments.

Identifiers: *Effluent treatment, *Water consumption, Dyehouse wastes, Rinsing wastes, Textile mill wastes.

At a symposium sponsored by the Society of Dyers and Colourists (London), two papers dealt with textile wastes and treatment thereof: Surface Active Agents in Processes and Effluents, by W. V. Barnes and S. Dobson, and Treatment of Effluents, by A. H. Little. (1) On today's market, 300-400 commercial surfactants are available in the United Kingdom and 2,000 - 3,000 in the United States. Along with giving the main classes of Textile Surfactants, the authors listed ten considerations which would lead to a suitable choice: (a) Nature of fiber, type of sail, and kind of machine used, (b) Foaming present or not, (c) Hardness of water, (d) Stability in presence of acids alkalis and metal salts, (e) Compatiblity with dyestuff and finish, (f) Absorption characteristics, (g) Cost, (h) Physical form, (i) Activity at low concentration, and (j) Influence on effluents. (2) The treatment of effluents is inevitable in today's textile industry. The surfactant used has much to do with the treatment afforded. This treatment determines the waste's acceptability by sewage works and must be dealt with early. The author in answering a question about rubber latex in the effluent gave a use for the waste. He commented his company had allowed the latex to collect on pebbles used as a filter. When these pebbles were completely coated they were used for a new covering of the parking lot. (Robinson-North Carolina State)

W70-07959

RECENT PROGRESS IN TREATMENT OF TEXTILE WASTE WATERS,

Peter W. Sherwood.

Canadian Textile Journal, Vol 82, p 40-43, September 3, 1965, 1 fig, 1 tab.

Descriptors: *Textiles, *Waste water treatment, *Oil wastes, Acidity, Alkalinity, Salts, Organic acids, Phenols, Soaps, Suspended load, Turbidity, Sulphur compounds, Nitrogen compounds, Odor, Taste, Oxygen requirements, Flow separation, Turbulence, Centrifugal pumps, Condensors, Filtration, Hydrogen ion concentration, Toxicity, Hardness, Separation techniques, Phosphorous compounds, Chlorine.

Identifiers: *Oil-in-water emulsions, Biological growths, Gravity separators, Demulsification, Aluminum compounds, Hydrogen-fluorene compounds, Sodium hypochlorite.

A classification of aqueous contaminants arising from textile operations breaks down into these categories: oil, both free and emulsified; acid or alkaline solutions; inorganic salts; organic acids and phenols or soaps of these compounds; suspended solids that increase turbidity; and various phenolic, naphthenic, and organic sulphur and nitrogen compounds, toxic to marine life and causing unpleasant odors and tastes in water. Many of these organic compounds have a high oxygen demand. Biological growths occur in some of these wastes. For decontamination of oil-containing separable waters, gravity separators are used, but oil-water emulsions require chemical or electrical demulsifications processes. Three flow systems, recirculation, split flow, and pressurized flow, were studied. Recirculation was not used, but the method adopted proved highly effective, especially when activated silica and alum were added. Heat, chemical, and electrical costs used to treat oil-water emulsions may be reduced by jointly treating the emulsions and chemical wastes. Turbulent flow, centrifugal pumps, barometric condensers, and steam syphons should be avoided whenever possible because they favor formation of emulsions. Filtration can break up some emulsions by removing the stabilizing solids. Chemical factors which must be considered in textile wastes are pH, taste and odor, oxygen demand, toxicity, hardness, and suspended solids. Particularly troublesome regarding taste and odor are phenolic compounds and nitrogen bases, but extractive methods can reduce their nuisance. Aluminum chloride and phosphoric acids should be neutralized and HF-containing tars and aqueous

liquers must be given special attention. Liquid chlorine or sodium hypochlorite control bacteria growths. (London-North Carolina State)

W70-07960

NEW PROCESS FOR THE TREATMENT OF EFFLUENTS IN THE TEXTILE INDUSTRY (IN GERMAN),

Heinrich Riemer.

Zietschrift fur die Gesamte Textil Industrie, Vol 64, No 4, p 299-304, 1962, 3 fig, 4 tab.

Descriptors: *Flocculation, *Aeration, *Effluents, Storage tanks, Surfactants, Organic compounds, Adsorption, Resins, Costs, Chemical precipitation, Treatment facilities, *Waste water treatment.

Identifiers: Impurities, Dyes, Surface skin, Residues, Plant layout.

A new process which dispenses with the need for a large storage vessel and is thus particularly recommended for industrial concerns in highly built-up areas consists in the addition of a flocculating agent to and intense aeration of the effluent with simultaneous pH adjustment. This precipitates solid and colloidal impurities as a surface skin which can be easily removed, while residues of dyes, surface-active agents, and organic compounds are removed by adsorption into artificial resins. Typical layouts for the treatment plant are shown and costs are discussed. (Livengood-North Carolina State)

W70-07961

DOW SURFPAC PILOT STUDY ON TEXTILE WASTE,

Crompton-Shenandoah Co., Inc., Waynesboro, Va.

Duane W. Snyder.

Purdue University Engineering Extension Department, Extension Series No 115, p 476-482, 1963, 5 fig, 2 tab, 2 ref.

Descriptors: *Biological treatment, *Biological oxygen demand, *Trickling filters, *Waste water treatment, Waste water (Pollution), Pilot plants, Lagoon.

Identifiers: *Textile mill wastes, Shenandoah River.

At the Waynesboro, Virginia, plant of Crompton-Shenandoah Co., Inc., manufacturing corduroys, velvets, and velveteens, measures have been taken to modify plant processes to reduce the strength of the waste waters, which are discharged to South river, a tributary of the Shenandoah River. In view of the need to reduce the BOD of the effluent still further, various treatment processes were investigated, and pilot-plant studies were made on biological filtration, using synthetic Surfpac medium; results are tabulated, showing that the process was stable to shock loadings and the BOD was reduced by at least 50 per cent. The data obtained have been used to design a full-scale treatment plant which will also have an equalization pond, to permit operation over a 7-day period, and a final sedimentation tank; this should increase the reduction in BOD to 60-70 per cent. (Livengood and Work-North Carolina State)

W70-07962

INDUSTRIAL WASTES FROM SCOURING RUG WOOLS AND THE REMOVAL OF DIELDRIN, Wiedeman and Singleton, Atlanta, Ga.

Robert D. Wilroy.

Proceedings of the Industrial Waste Conference, 18th, 1964, p 413-417.

Descriptors: *Dieldrin, *Waste water treatment, Streams, Suspended load, Screens, Sedimentation, Waste storage, Rivers, Septic tanks, Sewage, Fish, Dewatering, Sludge, Inorganic compounds, Effluents, Biochemical oxygen demand, Waste treatment, Lagoons, Solid wastes, Insecticides, Aquatic environment, Sedimentation.

Identifiers: Wool, Grit, Grease, Insect resistance treatments, Dyeing, Dyes, Decomposition, Equalization, Sand beds, Carpet mill wastes, Dyestuffs, Dyehouse wastes, Wool scouring.

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When it was planned to construct a rug manufacturing plant in southeast USA, detailed studies were made on the composition of the waste waters, the condition of the receiving stream, and the best type of treatment. The coarse heavy wool used in weaving rugs has a high concentration of grit and inorganic suspended solids and a low initial grease content. It was learned that the waste waters would also contain large amounts of dieldrin, used for moth-proofing the wool, and there would also be waste waters from the dyeing process. The treatment facilities constructed consisted of fine screens, a sedimentation tank, and a baffled equalization lagoon to provide a long detention period with automatic discharge of the effluent at a rate proportional to the flow in the river. Waste waters from the dyeing process are discharged to a small creek flowing into the river, except when the dyeing processes are deep red and black dyes are to be dumped, when the waste water is diverted to the lagoon. Effluent from the septic tank treating sanitary sewage is also discharged to the lagoon. Although the lagoon was designed only for equalization, there is evidence that active anaerobic decomposition is occurring, with reductions in BOD of 80-90 percent. The concentration of dieldrin in the final effluent is about 0.25 mg/l, and when diluted with river water this should be reduced to 0.0005 mg/l, which is much less than the mean tolerance limit for the fish in the river. Some difficulty was experienced in dewatering the sludge on the sand beds, since the very fine wool and grease form an impervious layer on top of the sand and excess water collects on top of this. At present, the excess water is removed by pumping and the sludge dries rapidly. A dewatering system is to be installed. (Livengood-North Carolina State) W70-07963

SIMPLE BIO-AERATION KILLS STRONG WASTES CHEAPLY,

Frances Ridgway.
Chemical Engineering, Vol 70, No 1, p 40-41, 1963.

Descriptors: *Biochemical oxygen demand, *Microorganisms, *Costs, Textiles, Sewage, Settling basins, Starch, Desizing wastes, Waste water treatment.
Identifiers: Aeration, Non-toxic wastes, Baffles, *Textile mill wastes.

A new bio-aeration system, based on action of microorganisms in a one-stage, prolonged process, is helping textile mills remove up to 90 percent of biochemical oxygen demand from strong starch desizing wastes. Developed by R. H. Souther, Greensboro, North Carolina, the process has four major advantages: (1) lower operational cost, (2) elimination of primary settling tanks and anaerobic sludge digesters, (3) decreases in the adverse effect from variable flow, changes in pH, and shock organic loadings in treatment of sewage and non-toxic organic wastes, and (4) increased flexibility in the use of air to obtain desired effluent characteristics. Waste water passes through a bar screen and a measuring device into an aeration tank, then through baffles to a final settling tank, and finally over weirs to the receiving stream. Sludge is returned to the influent end of the aeration tank to obtain highest BOD efficiency. Operating costs average 0.6 cents per pound of BOD influent per day, about 33 percent less than the cost for a conventional treatment plant. (Dandridge-North Carolina State) W70-07964

ECONOMICAL UTILIZATION OF CAUSTIC SODA IN COTTON BLEACHERIES,

Allied Chemical Corp., New York. Textile Section.
W. R. Steele.
American Dyestuff Reporter, Vol 51, No 1, p 29-30, 1962.

Descriptors: *Costs, Air pollution, *Filtration, Cotton, Dialysis, Waste water treatment.
Identifiers: *Caustic soda, Sodium hydroxide, *Bleaching wastes.

Procedures have been developed for increasing the quantity and concentration of recovered caustic soda liquor to permit reuse of the maximum amount of caustic soda without reconditioning. If the concentration of caustic used liquor is not too low, it can be evaporated, purified, and reused. Because impurities must be concentrated before evaporation, filtration is required. Sometimes, dialysis is necessary to reduce soluble impurity content. A caustic reutilization survey may show that, although collection, filtration, evaporation, dialyzation, and re-evaporation may be needed, annual cost savings may exceed 50 percent. Beneficial side effects such as increased yardage return and alleviation of water and air pollution may also be obtained. (Dandridge-North Carolina State) W70-07965

TREATMENT OF TEXTILE WASTES IN AERATED LAGOONS,

O'Brien and Gere, Syracuse, N.Y.
Samuel W. Williams, Jr., and George A. Hutto, Jr.
Proceedings of the Industrial Waste Conference, 16th, 1962, p 518-529. 7 fig, 2 tab.

Descriptors: *Waste storage, *Aeration, *Pilot plants, Chemical precipitation, Filtration, Sedimentation, Coagulation, Biological treatment, Biochemical oxygen demand, Cotton, Sludge, Sewers, Foaming, Sprays, Waste water treatment.
Identifiers: *Textile mill wastes, *Dyehouse wastes, Man-made fibers, Anti-foaming agents, Dyeing, Finishing, Caustic recovery, Starch.

The authors describe pilot-plant studies on treatment of waste waters from two textile mills of Burlington Industries, Inc. The plant at Mooresville, North Carolina, is an integrated cotton textile mill; various process modifications were made to reduce the volume strength of the waste waters, including installation of a caustic recovery unit and use of CMC instead of starch. Pilot-plant studies on treatment of the waste waters by chemical coagulation, biological filtration, and lagooning showed that good results could be obtained in aerated lagoons, and full-scale plant is being constructed; it will consist of two aerated lagoons with detention periods of 48 hours, and two sedimentation lagoons with detention periods of 12 hours with provision for recirculation of effluent if required. Sludge from the lagoons will be discharged to the municipal sewers. Foaming in the aerated lagoons will be controlled by addition of antifoaming agents, but sprays can be installed later if required. The mill at Wake Forest, North Carolina, receives fabrics from other mills for dyeing and finishing. In view of the successful results obtained with the aerated lagoons at the Mooresville plants, similar pilot-plant lagoons have been constructed at Wake Forest and are giving good results, with reductions in BOD of 75-80 percent. (Livengood-North Carolina State) W70-07966

PRECIPITATION OF DIRECT DYES AND ACID DYES BY IRON SALTS (IN JAPANESE),

H. Iida, and M. Endo.
English summary included. Kogyo Kwagaku Zasshi, Vol 70, p 403-404, 1967. 4 ref.

Descriptors: *Chemical precipitation, Sodium sulfate, Waste water treatment.
Identifiers: *Direct dyes, *Acid dyes, *Iron salts, Clarification, Dyehouse wastes, Ferric chloride, Ferrous sulfate, Dyestuffs.

In order to obtain basic data for the clarification of industrial waste water containing dye, 18 direct dyes and six acid dyes were precipitated from each aqueous solution by the addition of ferric chloride or ferrous sulfate, and the amounts of precipitated dyes was determined. From the results it was found that ferric chloride and ferrous sulfate were excellent for the precipitation of direct dye, but were not useful for acid dye. It was difficult to precipitate acid dyes from their aqueous solution containing sodium sulfate by the above method. (Livengood-North Carolina State) W70-07967

THE EFFECT OF SURFACE-ACTIVE AGENTS ON THE BIOCHEMICAL PURIFICATION OF EFFLUENTS FROM TEXTILE MILLS (IN RUSSIAN),

S. V. Yakovlev, Y. M. Laskov, and Yu-Lin Yo.
Vodosnabzhenie i Sanitarnaya Tekhnika, Vol 9, p 12-14, 1963.

Descriptors: *Effluents, Aerobic treatment, Cotton, BOD, Sewage treatment, Sulfite liquors, *Water purification, Waste water treatment.

Identifiers: *Biochemical purification, Printing, Sulfite liquors, Cotton mill wastes, *Textile printing plant wastes.

As a result of widespread use of surface-active agents in the textile industry, the effluents from textile mills contain 50-125 mg/l of such agents, and higher concentrations can be expected in the future. The effect of these on the biochemical purification of effluents was studied in laboratory models of aeration tanks. The experiments were conducted on effluents from a textile printing plant to which various amounts of the most widely used surfactants were added, and on effluents from a cotton mill, containing surfactants in a total concentration of 60-130 mg/l. As determined by the reduction of BOD and organic chemicals demand, the addition of 20 mg/l of sulfanoles had no significant effect on the biochemical purification process. Higher concentrations substantially reduced and purification efficiency. In experiments with the cotton-mill effluents, satisfactory purification was obtained when the effluents were diluted with 40-100 percent domestic sewage, the needed amount of the diluent being determined by the nature and concentration of I, their maximum permissible concentration for effective purification ranged from 35 to 70 mg/l. (Livengood and Dandridge-North Carolina State) W70-07968

DIMETHYLFORMAMIDE IN BIOLOGICAL PURIFICATION OF WASTE WATER (IN GERMAN),

M. Thonke, and W. Dittmann.
Fortschritte des Wasserchemie Ihre Grenzgebiete, Vol. 4, p272-277, 1966.

Descriptors: *Dimethylformamide, *Acrylic fibers, Activated sludge, *Waste water treatment, *Biological treatment.
Identifiers: Man-made fiber plant wastes, Solvents.

Dimethylformamide, present in the waste water from acrylic fiber production, is relatively quickly degraded by an activated sludge treatment and provides a source of carbon and nitrogen. (Livengood-North Carolina State) W70-07969

THE SEWAGE TREATMENT PLANT AT NORDHORN (IN GERMAN),

D. Kehr, and P. Pflanz.
Gas- und Wasserfach, Vol. 7, p260-266, 1966.

Descriptors: *Activated sludge, *Sludge digestion, Pilot plants, Anaerobic digestion, Aerobic digestion, Biochemical oxygen demand, Solid wastes, Turbidity, Waste water treatment.
Identifiers: Permanganate demand, *Textile mill wastes.

An illustrated account of the design and operation of the activated-sludge plant at Nordhorn, Germany, designed for treatment of both sewage and textile industry waste waters. Extensive pilot-plant experiments carried out to prevent putrescible matter from inhibiting sludge digestion led to replacement of the anaerobic sludge digestion unit by a specially developed aerobic sludge-stabilization plant which is odorless, less costly, and has proved most successful. Results showed removal of 70 percent of the permanganate demand and 93.5 percent of the 5-day BOD, leaving the effluent free from solids and reduced in turbidity. (C. Livengood - Robinson, North Carolina State) W70-07970

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

AERATION, SETTLING, AND CHLORINATION OF THE COMBINED WASTE FROM A VISCOSE FIBER PLANT (IN RUSSIAN),

O. P. Sinev.

Trudy Novocherkasskogo Politeknicheskogo Instituta, Vol. 162, p33-43, 1966.

Descriptors: *Cellulose, *Textiles, Sludge disposal, Chlorination, Filtration, Flocculation, Aeration, Waste water treatment.

Identifiers: Hydrocellulose, *Rayon plant wastes, Zinc compounds, *Carbon disulfide.

Aeration of waste waters at a rate of 10-10.4 cu m/cu m waste water reduced the CS₂ concentration from 41.6-82.3 to 5.2-9.0 mg/l, and H₂S from 13.7-26 to 1.45-3.1 mg/l. Combined precipitation of suspended solids at pH > or = 10 gave intensive flocculation and precipitation of hydrocellulose and better conditions for extension of Zn(OH)₂. Chlorination was most effective for a supplementary clarification after lime treatment and removal of suspended solids. The CL absorbability of the waste water after lime treatment, settling, and filtering through a sand filter was 46-73 mg/l. Residual CS₂ and H₂S concentrations in the waste waters at Cl₂ doses equal to Cl absorbability were 5.3-12.9 and 0-7.1 mg/l, respectively. A preliminary aeration of the waste waters at pH < 3 considerably reduced Cl absorbability. Chlorination of aerated waste waters ensured complete oxidation of H₂S and a decrease in CS₂ concentration to 0.94-2.5 mg/l. and BOD to 32-60 mg/l. (Rhine-North Carolina State)

W70-07971

STUDIES ON THE TREATMENT OF WASTE WATERS FROM THE TEXTILE INDUSTRY (IN RUMANIAN).

E. Mambet, E. Cute, and L. Weiner.

Summaries in Russian, French and English. Studii de Protectia si Epurarea Apelor, Vol. 4, p307-332, 1962.

Descriptors: Cotton, Biochemical oxygen demand, Calcium chloride, *Waste water treatment.

Identifiers: *Dyehouse wastes, *Textile mill wastes, Wool scouring, Man-made fibers, Wool, Fabrics, Dyestuffs, Color.

Tests were conducted on the textile mill wastes which are most difficult to treat: those from the scouring of wool, spinning of natural silk, and finishing of fabrics containing cotton, wool, and man-made fibers. Data on the physico-chemical characteristics of the waste waters are reported in tables and graphs, and pilot-plant studies are described on possible methods of treatment of waste waters from the finishing of wool and man-made fibers. The wool finishing waste waters were generally alkaline, with a five-day BOD of 390-317.0 mg/l. and a highly variable color which disappeared at dilution between 1/5 and 1/500. With the finishing waste waters from man-made fibers, the color disappeared at dilutions between 1/7 and 1/10, the pH value was 6.5-9.0, and the five-day BOD was 85.0-130.0 mg/l. The best color removal, with simultaneous improvement of pH value, was obtained by treating the wool finishing waste waters with calcium chloride and aluminum sulfate in doses of 1.0-2.0 kg and .2 kg/cu m, respectively. These treatments also reduced the quantity of sludge produced by chemical treatment of the waste waters. After this treatment for color removal, waste waters resemble domestic sewage and can be treated biologically. (Work-North Carolina State)

W70-07973

INDUSTRIAL WASTES AND SALVAGE: CONSERVATION AND UTILIZATION,

C. H. Lipsett.

Atlas Publishing Company, New York, 1963, 2d Ed., 406 p.

Descriptors: *Dialysis, Sodium sulfate, Evaporation, Crystallization, Filtration, *Waste treatment.

Identifiers: *Caustic soda, *Rayon, *Dialysis, *Carbon disulfide, Viscose rayon, Man-made fiber plant wastes, Sodium hydroxide.

Except for Chapter 45 (p.258) the textile wastes referred to in this book consists of rags, threads, yarns and the like which are commercially salvageable. Caustic soda (sodium hydroxide) from the viscose rayon precipitating bath is recovered by dialysis, sodium sulfate is removed by vacuum evaporation followed by cooling, crystallization and filtration. Carbon disulfide in wash water is removed by vaporization before the waste water is discharged to the sewer. (Work-North Carolina State)

W70-07974

THE PURIFICATION OF WASTE WATER IN THE PRODUCTION OF POLYAMIDE-FIBER (IN GERMAN),

J. Kaeding.

Fortschritte der Wasserchemie und Ihrer Grenzgebiete, Vol. 5, p258-283, 1967. 13 ref.

Descriptors: *Biological treatment, *Chemical precipitation, Activated sludge, *Waste water treatment.

Identifiers: *Polyamides, Nylon-6, Man-Made fiber plant, Caprolactam.

Water from the production of nylon-6 was contaminated with organic substances, such as caprolactam oligomers, other by-products and detergents. Waste water purification by the activated sludge process was studied. Laboratory scale tests were carried out on a two-stage biological treatment followed by flocculation. The purification depended on the concentration of the influx and on the load. The conversion rate increased with the influx concentration. Holding time of 6 to 8 hours sufficed for the decomposition, with 30 deg C being better than at 20 deg C. The water containing only lactam was more readily purified than the waste water from the polymerization and the polyamide fiber production. The lactam was consumed by the micro organisms, so that only phosphates had to be added for microbial decomposition. Substances not easily biodegradable were removed from the waste water by absorption with coagulants such as aluminum sulfate, ferric chloride, ferrous sulfate and calcium hydroxide and the decomposition capacity was then approximately that of lactam-containing water. (Work-North Carolina State)

W70-07975

EXPERIENCE IN DECONTAMINATION OF EFFLUENTS FROM THE RODNIKOVSKY SPINNING MILL (IN RUSSIAN),

L. V. Krasovskii.

Gigiena i Sanitariya, Vol. 32, No. 7, p98-99, 1967.

Descriptors: *Coliforms, *Irradiation, Color, pH, Biochemical oxygen demand, *Chlorination, Chlorine, Waste water treatment.

Identifiers: *Textile mill wastes.

A table is given showing the change in color, pH, suspended solids and B.O.D. produced by a purification plant involving sand traps, settling basins, and aero-tanks. The coliforms required chlorination and a graph of residual chlorine vs. dosage is included. Promising reduction of coli-index and number of colonies were obtained with irradiation by using a low-pressure Ar-Hg lamp. The lamp was 55 mm. above the surface of the water, the depth was 75 mm., and the width of stream 140 mm. At 0.14 liters/seconds, this resulted in a 30-second exposure. (Work-North Carolina State)

W70-07976

WASTE WATER TREATMENT IN MODERN TEXTILE OPERATIONS (IN GERMAN),

H. F. Kuisel.

Oesterreichische-Abwasser-Rundschau, Vol. 11, No. 5, p80-84, 1966.

Descriptors: *Activated sludge, pH, Biochemical Oxygen Demand, Chlorine, *Legal aspects, Chemicals, Legislation, Color, Waste water treatment.

Identifiers: *Dyestuffs, *Textile mill wastes.

Utilization of Lake Constance as a drinking water reservoir, and an agreement between Austria, Germany and Switzerland, placed limitations on waste water discharged into the lake. The limitations suspended solids <0.3, organic solvents and extractable matter; by petroleum ether <10; B.O.D. <25; KMnO₄ consumption <80 mg/liter, and absence of toxic matter; and temperature <30 deg g. Activated sludge is poisoned by chemicals used in the textile industry (phenol, ureaformaldehyde, oil, mineral oils) as these are liberated in biological treatment. Collection and mixing of all effluents of a textile plant is a partial solution to this problem. Excess chlorine decolorizes dyes in solution. The temperature can be controlled by a heat exchanger, which also results in a fuel savings. The water is clarified and treated by activated sludge, to be used as an organic fertilizer. High pH and B.O.D. are reduced by aeration for 48 hours; hard detergents are to be excluded either by legislation or voluntarily. Phenol is to be removed in the plant by ion exchange, and may be recovered. Examples are given of treatment in various textile plants. (Work-North Carolina State)

W70-07977

DEVELOPMENT OF A METHOD FOR TREATING WASTE WATERS CONTAINING SULPHUR DYES FROM THE 'ASEN ZLATAROV' PLANT, ISKAR STATION, SOFIA (IN BULGARIAN),

Kh. Popov.

English Summary. Trudy Nauchnoizledovatel'skiy Institut Vodosnabzheniya Kanalizatsiya Samarnaya Tekhnika, Sofia, Vol. 2, p167-184, 1965.

Descriptors: *Chemical reactions, Chemical precipitation, Laboratory tests, *Waste water treatment.

Identifiers: *Sulfur dyes, *Dyehouse wastes, *Dyestuffs.

Laboratory tests showed that the most economical and effective method for the treatment of waste waters containing sulphur dyes was acidification with sulphuric acid to give a pH value of 3.5-4, followed by neutralization with lime to give a pH value of 8-8.5, the neutralization tanks being closed and slightly pressurized. The sulphur dioxide and hydrogen sulphide which are evolved react together and become harmless, and the treated waste water is suitable for discharge to the municipal sewer. Based on the results of the tests, which are given in tables and graphs, a treatment plant was designed and is shown diagrammatically. The pH value during acidification and neutralization will be controlled automatically. A period of 2-2.5 hours is required for sedimentation and 1-1.5 hours for neutralization. Alkaline sludge can be reused. (Work-North Carolina State)

W70-07978

TEXTILE WATER POLLUTION CLEANUP PICKS UP SPEED,

R. W. Pinault.

Textile World, Vol. 117, p52-66, 1967. 1 tab, 1 fig, 17 pictures.

Descriptors: *Cost Analysis, Lagoons, *Waste water treatment.

Identifiers: *Textile mill wastes, Dyeing, Fabric finishing, *Dyehouse wastes.

It is estimated that the textile industry will be required to spend \$350 million dollars in the next 10 years to reduce the pollution from their plants to an acceptable level. For a plant dyeing and finishing 150 million yards of fabric a year, an added cost may be about one-tenth of a cent per yard. The operations of five plants are described. These are: (1) plant for the dyeing and bleaching of tricot

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abric made from man-made fibers, (2) a plant where color is removed by treating with lime and setting in a lagoon, (3) a plant where color was not a problem and uses aeration lagoons, (4) a printing and finishing plant using 9 to 10 million gallons of water per day, and (5) a mill which can discharge waste water, after treatment, into a large fresh water lake. (Work-North Carolina State)
W70-07979

WATER POLLUTION ABATEMENT BY IMPROVED COAGULATION OF EFFLUENTS FROM LYE-PEEL POTATO PROCESSING PLANTS,

North Dakota Water Resources Research Inst, Far-

o.
Guilford O. Fossum, and Albert M. Cooley.

Available from the Clearinghouse as PB-192 632, \$3.00 in paper copy, \$0.65 in microfiche. Research Project Technical Completion Report, Water Resources Research Institute WI221-006-70, Jan 1970. 29 p, 12 tab, 7 fig, 3 ref. OWRR Project A-002-NDAK (1).

Descriptors: Coagulant aids, *Coagulation/COD reduction, Floc formation, Food processing wastes, *Leonardite, *Lye-peel waste, Neutralization of waste, *Polyelectrolyte use, *Potato processing wastes.

Identifiers: Coagulation, Sedimentation, Zeta potential, *Pollution abatement, Potatoes, Humic acids, *Waste water treatment.

The lye-peel process produces a waste from the peeling stage which is very high in organic content and has a pH of 12 or more. This high alkalinity and the colloidal nature of the organic solids make their removal by coagulation very difficult. Leonardite is a naturally-occurring material consisting of humic acids. It can be made colloidal in water and then precipitated as a floc or gel. The possibility of using this floc to aid in removing the organic solids from lye-peel waste is discussed. The addition of leonardite to lye-peel waste in combination with other prime coagulants formed a dense settleable floc. However, at high values of pH, the floc was ineffective as it actually resulted in increased COD values for the supernatant liquor after two-hour settling. At neutral or acidic pH values the leonardite did assist in removal of solids. Even in these cases, however, the supernatant was not clear but was dark-colored from the unprecipitated leonardite. The addition of polyelectrolyte coagulant aids further improved the COD reduction. The cationic polyelectrolytes were considerably more effective than nonionic ones. Lowering of the pH by natural fermentation instead of by acid addition did not materially alter the results.
W70-07995

STATE OF THE ART REVIEW ON PRODUCT RECOVERY.

Resource Engineering Associates, Wilton, Conn.

Available from the Clearinghouse as PB-192 634, \$3.00 in paper copy, \$0.65 in microfiche. Water Pollution Control Research Series, Nov 1969. 95 p, 7 tab, 18 fig, 106 ref, 3 append. FWQ Project 17070 DJW-11/69, Contract No. 14-12-495.

Descriptors: Waste water treatment, *Reviews, *Waste treatment, Solid wastes, *Industrial wastes, Liquid wastes, *Byproducts.

Identifiers: By-product recovery, *Recovery, *Reuse, Product recovery, Industrial waste recovery.

The recovery, reuse and sale of materials from liquid effluents, or produced as a result of the treatment of liquid effluents is discussed. A critical review of literature up to date on product recovery in major water use industries is presented. The economical, technical and philosophical framework which determines the application of product recovery is presented wherever possible. This report does not cover water renovation for reuse and product recovery from solid wastes.

However, an evaluation of the utilization and product recovery of municipal sludge is presented. The principal areas of discussion are waste reduction practices including in-plant control, recovery techniques and practices, practical operating problems and the relationship between recovery and treatment. It is concluded that product recovery is an accepted practice with increasing usage; industry needs increasingly complex processes to develop optimum recovery schemes; by-product recovery results in a net cost to industry generally of a smaller magnitude than conventional treatment; and the situation is complicated by the tax exemption laws.
W70-07997

AEROBIC TREATMENT OF TEXTILE MILL WASTE,

E. L. Jones, T. A. Alspaugh, and H. B. Stokes. Journal of the Water Pollution Control Federation, Vol 34, p 495-512, 1962.

Descriptors: *Aerobic treatment, *Activated sludge, *Contact stabilization, Biological treatment, Biochemical oxygen demand, Chlorination, *Waste water treatment.

Identifiers: *Textile mill wastes, Aerobic stabilization.

A full-scale, single-stage modification was made of the conventional activated sludge process to the contact stabilization process. The results of further pilot-plant studies on the biological treatment of textile waste waters in admixture with sewage at Greensboro, N.C. are given and discussed. Contact stabilization and prolonged aerobic stabilization modifications of the activated sludge process were investigated. The contact stabilization was found to give good results with mixtures in which about half the BOD load was contributed by textile wastes and reductions in BOD of 85-90% were obtained without chlorination; good color removals were also obtained. (Livengood-North Carolina State Univ)
W70-08133

PROBLEMS OF WASTE WATER DISPOSAL IN THE TEXTILE INDUSTRY (IN GERMAN),

M. Kehren. Mellandi Textilberichte, Vol 11, p 1274-1276 and Vol 12, p 1291-1395, 1963.

Descriptors: *Detergents, Waste water disposal, Sludge treatment, Waste water treatment.

Identifiers: *Turofloc process, Dyehouse wastes, Dyes, *Textile mill wastes, Biological purification, Clarification, Aluminum chloride, Synthetic resins, Sodium hydroxide.

The problem is discussed of detergents in effluent, in particular the limiting quantities which can interfere with biological purification systems. The recent Swiss Turofloc process is described. This can produce clarification and removal of dyestuffs and detergents by direct flocculation by treatment with aluminum chloride. This is followed by sludge removal and clarification over a synthetic resin, which is regenerated with caustic soda. (Livengood-North Carolina State Univ)
W70-08134

DISPOSAL OF INDUSTRIAL WASTES AT MAITLAND, ONTARIO, WORKS OF DUPONT OF CANADA,

DuPont of Canada Ltd., Maitland (Ontario).

R. F. Walker.

Proceeding of the Industrial Waste Conference, 12th, p 720-729, 1958. 4 fig, 3 tab, 3 ref.

Descriptors: *Chlorination, *Neutralization, *Chemical plant wastes, *Industrial wastes, Chemical wastes, St. Lawrence River, Waste disposal.

Identifiers: *Acrylic fibers, *Chemical plant wastes, Oil removal, Imhoff tank, Freon (TN), Orlon (TN).

The Maitland, Ontario, plant of DuPont of Canada Ltd., manufactures nylon intermediates, 'Freon' fluorinated hydrocarbons, and 'Orlon' acrylic fibers. The sources and nature of the principal contaminants in the waste waters are shown in a table, together with a method of disposal. Combustible wastes are burned. Dilute chemical wastes are settled for removal of oil, neutralized if necessary, and discharged on the bed of the St. Lawrence River at a depth of 46 feet and a distance of 1,000 feet from the shore. Waste waters relatively free from contaminants are collected in an off-the-shore line. Sanitary wastes are digested in an Imhoff tank and chlorinated before discharges. (Livengood-North Carolina State Univ)
W70-08135

IRON TREATMENT OF WASTE WATERS CONTAINING DYES (IN GERMAN),

M. Kehren.

Berichte der Abwassertechnischen Vereinigung, No 8, p 219-227, 1957.

Descriptors: *Waste water treatment, *Industrial wastes, Cotton.

Identifiers: *Wool dyeing, *Cotton bleaching, *Cotton dyeing, *Iron, *Dyehouse wastes, *Iron salts, Composition, Bleaching, Wool dyes, Cotton dyes.

A table shows the composition of waste waters from the dyeing of wool and the bleaching and dyeing of cotton. The properties of the various types of dyes used are discussed. The results of investigations into the treatment of aqueous solutions of dyes with metallic iron and iron salts are given. (Livengood-North Carolina State Univ)
W70-08136

PROFITABLE USE OF WASTE MATERIALS IN COTTON MILLS,

Vasant Industrial and Engineering Works, Bombay (India).

V. S. Nathan.

Indian Textile Journal, Vol 64, p 763-764, 1954.

Descriptors: *Cotton, *Potassium compounds, Iron compounds, Waste water treatment, Industrial wastes.

Identifiers: *Textile mill wastes, Ferrous sulfate, Caustic soda, Tin compounds, *Alum, Lime, Chemical recovery.

Effluent waste water from the scouring and bleaching of cotton fabric can be treated with ferrous sulfate and air bubbled through it. Insoluble iron compounds settle out and after collection, the solids treated with sulfuric acid in order to recover fatty acids and iron sulfate. Potassium salts can be recovered from wool scouring wastes, in addition to the usual recovery of wool grease. The salts can be concentrated from the washing of silk. Waste water from the mercerizing of cotton can be concentrated to recover the caustic in it after other impurities are removed by precipitation with alum or lime. (Work-North Carolina State Univ)
W70-08137

DISPERSED GROWTH AERATION OF COTTON FINISHING WASTES. II. EFFECT OF HIGH pH AND LOWERED AIR RATE,

North Carolina State Univ., Raleigh.

N. L. Nemerow.

American Dyestuff Reporter, Vol 46, No 16, p 575-576, 1957. 1 tab, 1 ref.

Descriptors: *Biochemical Oxygen Demand, *Alkalinity, *Aeration, Cotton, *Cost analysis, Waste water treatment, Water pollution effects.

Identifiers: *Dyehouse wastes, Scouring, Mercerizing.

By reducing the amount of air and eliminating carbon dioxide used in the aeration and neutralization of highly alkaline waste water from a cotton scouring and mercerizing operation, a considerable dol-

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lar saving was effected. But in so doing the reduction in the B.O.D. of the discharged water dropped from 71 percent to 33.6 percent. (Work-North Carolina State Univ)
W70-08138

THE CHEMICAL CONDITION OF WASTE WATERS FROM THE TEXTILE INDUSTRY (IN GERMAN),
M. Kehren.
Gas- und Wasserfach, Vol 99, p 544-545, 1958.

Descriptors: *Chemical properties, *Chemical precipitation, Alkalinity, Foaming, Waste water treatment.
Identifiers: *Textile mill wastes, Iron salts, Rinsing waters.

Alkaline rinsing water from the textile industry contains, in addition to comparatively easily removed fibrous and other insoluble matter, colloidally dissolved wetting and washing agents which cannot be biologically treated. Chemical precipitation with iron is the only successful method although foaming, which is comparatively harmless, cannot be completely avoided. (Livengood-North Carolina State Univ)
W70-08139

WOOL INDUSTRY WASTE WATERS (IN RUSSIAN),
J. Nowacki.
Gaz. Woda i Technika Sanitarna, No 3, p 65-90, 1956.

Descriptors: *Waste water treatment, *Waste water disposal, Waste waters, Coagulation, Lime.
Identifiers: *Wool dyeing, *Municipal sewers, *Sulfuric acid, *Ferric sulphate, Acid chrome dyes, Mordant dyes, Dyehouse wastes.

Laboratory experiments have been carried out at the Silesian Technological Institution on the preliminary treatment of waste waters from the wool industry before discharge to the municipal sewers. Waste waters containing acid chrome and metachrome dyes can be treated with H₂SO₄ and FeSO₄ and mixed in an equalization tank with waste waters from the washing houses and with dye wastes previously treated with coagulation with lime and ferrous sulfate. Finally the mixed waste waters are settled before discharge. (Mattox-North Carolina State Univ)
W70-08140

POLLUTION CONTROL BY RECOVERY OF CAUSTIC SODA,
Solvay Process Div., Allied Chemical Corp., Syracuse, N.Y.
W. R. Steele.
American Dyestuff Reporter, Vol 44, No 12, p 400, 1955.

Descriptors: *Waste water treatment, Water pollution control.
Identifiers: *Caustic soda, *Recovery (Waste), *Textile mill wastes.

Eighty percent of caustic entering a bleaching operation is not consumed and can be recovered. The keys to recovery are washing out caustic on the tenter frame and increasing the concentration of caustic in wash liquors. Concentrated caustic solutions can be reused directly, and dilute solutions can be evaporated and concentrated for use in mercerization. High-purity caustic can also be removed. Efficient removal of caustic from cotton decreases shrinkage. (Sheffield-North Carolina State Univ)
W70-08143

BASIC STUDIES ON THE CLARIFICATION OF WASTE WATER CONTAINING DYES. I. PRECIPITATION OF DIRECT DYES BY FERRIC CHLORIDE,
H. Iida, and N. Kuwahara.

Representative Government Chemical Industries Research Institute, Tokyo, Vol 58, No 3, p 137-144, 1963.

Descriptors: *Chemical precipitation, Centrifugation, Sodium sulfate, *Waste water treatment.
Identifiers: *Flocculation, *Direct dyes, *Ferric chloride, Precipitation, Clarification, Dyehouse wastes, Dyestuffs.

In studies on the hetero flocculation of 5 direct dyes by ferric chloride from aqueous solutions, the precipitates were removed by centrifuging and the amount of unprecipitated dye was estimated colorimetrically. Precipitation was increased when the pH value was less than 5, and 95-100% of the dye was precipitated from a solution with 10 parts per million at pH 5 by the addition of 60-100 parts per million ferric chloride. Precipitation varied with the dye; some dyes precipitated in amounts less than 30% and others precipitated completely under the same conditions. With some dyes, precipitation was reduced by addition of sodium sulfate. (Robinson-North Carolina State Univ)
W70-08144

TREATMENT OF WOOL SCOURING LIQUORS,
E. W. Clark, and G. F. Kitchen.
Patent no. 1,029,114, May 11, 1965.

Descriptors: Flocculation, Filtration, Chemical precipitation, *Detergents, *Waste water treatment.
Identifiers: *Wool scouring, *Wool grease, *Ferrous sulfate, Sulfuric acid.

When synthetic detergents, rather than soap, are used to scour raw wool, it is quite difficult to separate the grease, suspended solids and dissolved solids from the waste water. A new and inexpensive method of so doing is based upon the use of ferrous sulfate (copperas). The preferred procedure is to treat the liquid with 0.2-1.5% of ferrous sulfate, blow with air at the boil, acidify with sulfuric acid to a pH of 1.0 to 4.0, boil for an hour, cool to room temperature and filter. By this process waste water containing about 2.0% wool grease, 3.5% total solids and possessing a 4 hour permanganate value of about 6000 p.p.m. can be reduced to 0.1%, 25 p.p.m. and about 3000 p.p.m., respectively. (Work-North Carolina State Univ)
W70-08145

THE ECONOMICS OF BASE METAL RECOVERY BY ION EXCHANGE,
Permutit Company, Paramus, N.J.

A. B. Mindler.
Metallurgical Society Conferences, Vol 14, p 851-859, 1963. Science Publishers, New York, 1964.

Descriptors: *Waste water treatment, *Copper, Ion-Exchange, Copper compounds.
Identifiers: *Viscose rayon wastes, *Cuprammonium rayon plant wastes, *Zinc, Zinc compounds, Rayon plant wastes.

Waste waters from the manufacture of viscose rayon contain zinc which can be recovered by passing the water through cation exchange beds (Permutit Q) at a rate of 1 g.p.m. per cubic foot of bed. The solution eluted from the bed containing 12-14% zinc sulfate, is sent back to the process as make-up. Waste water from the manufacture of cuprammonium rayon, in the only plant in the United States, contains copper compounds in solution which is recovered by passing the solution through a bed of Zeo-Karb, a sulfonated coal. (Work-North Carolina State Univ)
W70-08146

ACTIVATED CARBON RECLAIMS TEXTILE INDUSTRY'S WASTE WATERS.

Environmental Science and Technology, 3, p 314-315, 1969.

Descriptors: *Water reuse, Waste water treatment
*Reclaimed water, Textiles.
Identifiers: *Carpet mill wastes, *Textile mill wastes, Carbon beds.

Process waste water from a carpet mill will be passed through a moving carbon bed to remove impurities so that the recovered water may be reused in plant operations. The amount and kind of impurities are not stated, nor is the composition of the recovered water. (Work-North Carolina State Univ)
W70-08148

5E. Ultimate Disposal of Wastes

WATER AND EFFLUENTS,
Society of Dyers and Colourists, London (England).
For primary bibliographic entry see Field 05D.
W70-07959

STANZE V MEIER (INTERFERENCE WITH THE OPERATION OF DRAINS).
For primary bibliographic entry see Field 06E.
W70-08076

SYMPOSIUM ON WASTE-DISPOSAL PROBLEMS OF SOUTHERN MILLS,
American Association of Textile Chemists and Colorists, Durham, N.C.
For primary bibliographic entry see Field 05B.
W70-08141

5F. Water Treatment and Quality Alteration

SWAP CHEMICALS FOR CLEANER STREAMS,
Wesleyan Univ., Middletown, Conn.
For primary bibliographic entry see Field 05B.
W70-07972

ALGAE HANDLED EFFICIENTLY BY AUGUSTA WATER DISTRICT,
Augusta Water District, Maine.
Sidney S. Anthony.
Water and Sewage Works, Vol 116, p 185-189, 1969. 1 fig, 6 photos.

Descriptors: *Algae, *Maine, *Water supply, Copper sulfate, Reservoirs, Water pollution, Microorganisms, History, Taste, Odor, Deep wells, Water treatment, Mechanical equipment, Pumping plants, Maine.
Identifiers: *Augusta (Maine), Carleton Pond (Maine), Synura, Asterionella, Typhoid fever, Kennebec River (Maine), Cobbsseecontee Lake (Maine), Barge.

The history of the Augusta, Maine, water supply after 1870 is described. At that time the Kennebec River was used as the source of water; in the winter of 1902-1903 widespread typhoid fever outbreaks, traceable to the water supply, caused the inauguration of a water district. Carlton Pond, the principal reservoir, was chosen by the Augusta Water District and placed in operation in 1906. The pond, however, is subject to periodic infestations of algae, primarily Synura, with Asterionella also present. To alleviate the taste and odor problem caused by algae, control measures are taken. A special barge and pumps were developed for application of copper sulfate (the only chemical used) in dilution of 0.35 milligrams/liter. The treatment is completed in one day, in the fall, when water turbulence is minimal, and application is made to the entire lake and shoreline. One treatment is usually adequate to eliminate the algae. (Jones-Wisconsin)
W70-08096

ALGAL REMOVAL IN UNIT PROCESSES,

Environmental Control Administration, Cincinnati, Ohio; and Iowa Univ., Iowa City, Dept. of Environmental Health; and Iowa Univ., Iowa City, Dept. of Civil Engineering.

Ronald R. Speedy, Neil B. Fisher, and Donald B. McDonald.

Journal American Water Works Association, Vol 61, p 289-292, 1969. 1 fig, 5 tab, 6 ref.

Descriptors: *Algal control, *Potable water, Cyanophyta, Sulfur bacteria, Color, Iron bacteria, Taste, Filters, Iowa, Diatoms, Euglena, Chlamydomonas, Sampling, Scenedesmus, Chlorophyta, Chlorella, Chlorine, Lime, Coagulation.

Identifiers: *Unit processes, Gastroenteritis, Synura, Anabaena, Iowa River, Cyclotella, Fragilaria, Synedra, Navicula, Aphanizomenon, Oscillatoria, Melosira, Actinostroma, Coelastrum, Pediastrum, Westella, Stephanodiscus, Ankistrodesmus, Chloromonad, Alum.

A determination of the efficiency of algal removal in various unit operations of potable water treatment process was made. Samples were collected at various locations throughout the treatment plant and examined to determine kinds and numbers of algal forms present. The results indicate a wide disparity in the efficiency of algal removal among the several unit processes studied. Numerous organisms pass the filters into finished tap water; counts as high as 44 organisms/milliliter were obtained. Cyclotella and Chlorella appear with the greatest frequency in the plant effluent. The use of alum as a coagulant seems moderately effective for algal removal, but lime appears to be much more efficient due to formation of heavy floc which entraps the cells upon settling. Both types of filters effect a high degree of algal removal at the start of a filter run; the sand continues to show fairly efficient removal until the head loss goes above six feet. The anthrafil filter shows a higher number of algae passing through the filter. The importance of maintaining a chlorine residual is shown by the number of algae found in the finished tap water. (Jones-Wisconsin)
W70-08107

THE ECONOMICS OF BASE METAL RECOVERY BY ION EXCHANGE,

Permutit Company, Paramus, N.J.

For primary bibliographic entry see Field 05D.

W70-08146

COLOR IN INDUSTRIAL WASTES,

North Carolina State Univ., Raleigh.

Nelson L. Nemerow.

Journal of the Sanitary Engineering Division. Proceedings of the American Society of Civil Engineers, Vol 83, No SA1, February 1957, p 1180-1-1180-14. 4 fig, 11 ref.

Descriptors: *Chemical reactions, Color, Waste water treatment.

Identifiers: *Dyestuffs, Textile plant wastes, Dyehouse wastes.

It is estimated that about 25 million pounds per year of dyestuffs are discharged in the waste water from the dyeing of textiles and paper. The chemical composition of dyestuffs, classified as nitroso, nitro, azo, triphenylmethane, anthroquinone, sulfur and heterocyclic are illustrated with examples. It is proposed that the color of such materials can be reduced by appropriate chemical reactions. As an illustration, a procedure is developed to alter the color of methyl orange, an azo dye. (Work-North Carolina State Univ.)
W70-08147

5G. Water Quality Control**ROGERS V BOND BROS (WELL POLLUTED BY NEARBY CREOSOTE PLANT).**

279 Ky 239, 130 SW2d 22-24 (1939).

Descriptors: *Kentucky, *Artesian wells, *Water pollution, *Creosote, Soil contamination effects, Cities, Impaired water quality, Pollutants, Industrial wastes, Oily wastes, Groundwater, Water pollution effects, Water supply, Railroads, Legal aspects, Judicial decisions, Water law, Groundwater movement, Municipal water, Remedies, Damages, Potable water, Explosions, Land clearing, Wood preservatives (Pesticides).
Identifiers: *Negligence, *Nuisance.

Plaintiff owned an artesian well which was the local municipal water supply source. Over a period of years, a creosote plant was operated in the vicinity of the well location, first by a railroad company, then by defendant. After acquisition, defendant used dynamite to clear timber on the property. Shortly thereafter, plaintiff discovered his well was so polluted with creosote that the water was unfit for drinking. He brought suit alleging that the careless operation of the plant and the use of dynamite had caused the contamination of his well. The court first noted that the doctrine of absolute liability for one who harbors harmful substances on his property did not apply in Kentucky, and that the nuisance doctrine required the showing of continuing harm rather than an isolated invasion of rights. In holding for the defendant, the court stated that the evidence pertaining to the source of the creosote in the well was insufficient for submission to the jury. The court pointed out that the creosote pollution could have been the product of railroad company negligence and that defendant could not be liable since he was not a joint tort-feasor. The court also noted other possible sources of the contamination and ruled that plaintiff failed to prove a cause of action against defendant. (Hubener-Florida)
W70-07719

USE OF ACTIVATED SILICA IN WATER FOR TEXTILE FINISHING,

Brookneal Mills, Va.

Frederic A. Prisley.

Journal of the American Water Works Association, Vol 49, Pt 1, No 4, April 1957, p 459-463. 1 fig, 2 ref.

Descriptors: Flocculation, Rivers, Turbidity, Alkalinity, Ammonium compounds, Neutralization, Chlorine, Filtration, Waste water treatment.

Identifiers: *Activated silica, Alum, Sodium carbonate, Backwashing, Dyehouse wastes.

Activated silica increases speed of formation of aluminum floc as well as size, density, and strength. It is used at the Brookneal Filter Plant, which supplies a dyeing and finishing plant and the town of Brookneal, Virginia. The water comes from the Falling River and is quite soft. The raw water is allowed to settle and is then treated with alum and soda ash. Warm weather produces no problems other than rapid changes in turbidity and alkalinity due to heavy runoffs. Colder weather introduces problems of low turbidity and colder water, necessitating a maximum rate of filter operation. A test using PQN Sol A (the silicate), known as the N-sol process, was run, adding the sol in the flash mixer, and proved highly successful. Ammonium sulfate was used as a neutralizing agent in the test, but in permanent operation the chlorine itself was used. Installation of piping and a chlorine-feeding manifold was the major task necessary to put the system into operation. Results have shown that frequency of backwash was reduced, dumping of basins rose from every three months to every four weeks, filter rates were significantly increased, some chlorine residuals remained, and very little service was needed on the silica generator. (Lonon-North Carolina State)
W70-07740

USE OF TAXES, SUBSIDIES, AND REGULATIONS FOR POLLUTION ABATEMENT,

Clemson Univ., S.C. Water Resources Research Inst.

Hugh H. Macaulay.

Available from the Clearinghouse as PB-192 631, \$3.00 in paper copy, \$0.65 in microfiche. Water Resources Research Institute, Clemson University, Report No. 16, June 1970. 81 p, 6 fig, 29 ref. OWRR Project B-004-SC (9).

Descriptors: *Equilibrium prices, *Economic justification, *Welfare (Economics), Compensation, Taxes, *Water pollution control, Water quality, Regulation.

Identifiers: *Charges, *Subsidies, *Externalities.

The Knight and Coase articles on social costs (see W69-07188) are examined in the light of their relevance to water pollution. These articles emphasize the two-way nature of social costs that can be seen in congestion of highways. A mathematical presentation shows that the market solution of congestion is also Pareto-optimal. Forces that affect upstream and downstream costs are shown graphically and the optimal use of water quality derived. The presentation stresses the role of alternative opportunities and the public goods nature of water quality. A comparison of charges, subsidies, and regulations, shows that the latter two will result in an overdemand for stream quality. Charges are not subject to this defect. Externalities associated with water pollution are shown to conform to the Knight and Coase conditions; both upstream firms and downstream residents create external diseconomies for each other. As a consequence, the measures proposed for pollution abatement should be applied to all parties along the stream. The Buchanan, Stubblebein, Turvey argument that a charge must be coupled with a subsidy is shown to be inappropriate when all parties are charged for external diseconomies they create, or subsidized for those they forego. The relationship between pecuniary and technological externalities is discussed.
W70-07802

DESIGN AND OPERATION OF LARGE DESALTING PLANTS,

For primary bibliographic entry see Field 03A.

W70-07854

PHOTOSYNTHESIS AND OXYGEN BALANCE IN STREAMS,

Manhattan Coll., Bronx, N.Y. Dept. of Civil Engineering.

Donald J. O'Connor, and Dominic M. Di Toro.

Proceedings, American Society of Civil Engineers, J of the Sanit Eng Div, Vol 96, No SA2, Proc Paper 7240, p 547-571, April 1970. 25 p, 8 fig, 3 tab, 30 ref, 4 append.

Descriptors: *Mathematical studies, *Dissolved oxygen, *Photosynthetic oxygen, *Biochemical oxygen demand, *Time, Spatial distribution, Rivers, Streams, Steady flow, Temperature.

Identifiers: Algal oxygen source, Equation.

The equation expressing the dissolved oxygen balance in a flowing stream was mathematically formulated to include a time varying photosynthetic oxygen source. The solution to the equation was compared to diurnal dissolved oxygen data obtained from five streams for which the algal oxygen source was the primary cause of the diurnal dissolved oxygen fluctuation. A review of previous work was given and the theory used was presented. The importance of the nitrogenous component of BOD was also evident. The resulting agreement between the theoretical solution and the data indicated that the equation presented was an adequate representation of the dissolved oxygen balance in a time varying as well as spatially varying situation. The five rivers selected for analysis were the Grand River, the Clinton River, and the Flint River in Michigan; the Truckee River in Nevada, and the Ivel River in Great Britain. The data available was obtained during periods when a reasonable

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approximation of a steady-state flow and temperature prevailed. Fourier analysis of photosynthetic oxygen source and time varying deficit of DO were described in the appendices. (Kriss-Cornell)
W70-07857

MASONITE CORP V STEEDE (RELATIVE RIGHTS OF WATER USE AND DAMAGES FOR INDUSTRIAL POLLUTION).

23 So 2d 756-760 (Miss 1945).

Descriptors: *Mississippi, *Fishkill, *Competing uses, *Damages, Colloids, Effluents, Water pollution sources, Industrial wastes, Pulp wastes, Organic matter, Organic wastes, Path of pollutants, Pollutants, Water pollution effects, Riparian rights, Navigable waters, Relative rights, Riparian waters, Watercourses (Legal), Industrial plants, Judicial decisions, Legal aspects.

Plaintiff sought damages for the destruction of her business, a fishing resort on a navigable river. The destruction was allegedly the result of effluent which defendant corporation allowed to escape into the river. The court held that plaintiff and others who could gain access to the river had the right to take fish therefrom. Plaintiff had the right to control access to the river via her property. The court stated that damages were recoverable, for the destruction of these rights, and the related right to profit from business. The jury was warranted in finding that defendant's action materially contributed to, if not solely caused, the destruction of plaintiff's business. The court found, however, that plaintiff had not proved with reasonable certainty any loss of profits or damages, but went on to say that she was entitled to actual damages if she could prove them, and nominal damages if she could not. Furthermore, defendant could be held liable only for its proportionate share of the damage inflicted. (Price-Florida)
W70-07950

WATER POLLUTION ABATEMENT BY IMPROVED COAGULATION OF EFFLUENTS FROM LYE-PEEL POTATO PROCESSING PLANTS,

North Dakota Water Resources Research Inst, Fargo.

For primary bibliographic entry see Field 05D.

W70-07995

ULTRASONIC EMULSIFICATION OF OIL TANKER CARGO, FEASIBILITY STUDY USING AN ULTRASONIC PROCESS TO EMULSIFY PETROLEUM TO REDUCE OIL SLICK HAZARDS IN EVENT OF SPILLAGE AT SEA.

Sonics International, Inc., Dallas, Tex.

Available from the Clearinghouse as PB-192 633, \$3.00 in paper copy, \$0.65 in microfiche. Water Pollution Control Research Series, Apr 1970, 164 p, 58 tab, 86 fig. FWQA Program 15080-DJQ 04/70.

Descriptors: Toxicity, Tanker, *Water Pollution Control, *Emulsions Safety, Evaluation, Costs, *Emulsifiers, *Dispersion, *Oil spills, Oily water, Oil-water interfaces.

Identifiers: Continuous process, Ultrasonics, Transportation, Flammability, Tanker.

The purpose of this project was to study the feasibility of producing emulsified oil at a rate comparable with conventional tanker loading rates and to investigate the economic and ecological factors. To determine blender parameters and emulsified oil characteristics, two crude oils and one fuel oil were chosen. A Libyan light oil, a Venezuelan oil and No. 6 Fuel Oil were used. Only two emulsifiers were used and they were base-neutralized sulfonated nonionics. These are compatible with sea water and of low toxicity. The emulsions tested were oil-in-water. Oil was the internal phase and 97% of the total. Water and chemical was the ex-

ternal phase and 3% of the total. The tests on the emulsions were to determine: stability under simulated transportation conditions, dispersibility in sea water, toxicity to fish, and product alteration. Included were tests with safety aspects: evaporation rates, flash points, vapor pressures and rupture leak tests. An economic study was made which shows emulsification costs of about 20 cents per barrel without considering possible offsets or side benefits.
W70-07996

FAIRWOOD BLUFFS CONSERVANCY DISTRICT V IMEL (DISCHARGE OF RAW SEWAGE INTO OPEN DITCH).

255 NE2d 674-684 (Ind Ct App 1970).

Descriptors: *Indiana, *Sewage, *Easements, *Waste disposal, Cities, Right-of-way, Municipal wastes, Sewage districts, Water pollution sources, Sewage treatment, Ditches, Sewage disposal, Local governments, Waste water (Pollution), Damages, Erosion, Environmental effects, Bank erosion, Judicial decisions, Legal aspects, Remedies.

Defendant water conservancy district obtained an easement across plaintiff's property for construction of an enclosed sanitary sewer and an open ditch to carry storm water. The conservancy district promised that the storm water drain would never carry raw sewage or excessive quantities of water. Subsequently, large quantities of water were directed through the storm drainage ditch causing erosion of its banks. Raw sewage was also conveyed through the open ditch and plaintiffs were forced to abandon their home. In this action plaintiffs sought damages for nuisance, an injunction for its abatement, and cancellation of the easement. The appellate court affirmed the trial court's granting of damages, holding that the district was liable for damages in a civil action, as would be a municipal corporation, for creating and maintaining a nuisance by discharging raw sewage onto plaintiffs' land. (Hubener-Florida)
W70-07998

GRIGSBY V BD EDUC OF FLOYD COUNTY (CONSTRUCTION OF SEWAGE PLANT UPSTREAM FROM MUNICIPALITY).

542 SW2d 827-838 (Ky 1970).

Descriptors: *Kentucky, *Sewage treatment, *Municipal water, *Treatment facilities, Local governments, Water pollution, Waste treatment, Legislation, Administration, Water pollution control, Effluents, Public health, Water supply, Reasonable use, Water quality, Administrative agencies, Streams, Potable water, Adjudication procedure, Remedies, Sewage disposal, Sewage, Judicial decisions.

Defendant board of education obtained approval from the state Water Pollution Control Commission for a sewage-disposal system to be used in connection with a new high school situated on a certain creek. Plaintiffs, representing the citizens of a town downstream, sought to prevent construction of the disposal system alleging it would pollute the stream which furnished their public water supply. The court, pointing to substantial evidence indicating that the plant would adequately fulfill its purpose without causing pollution, held for defendants. The court stated that in such circumstances its scope of review was limited as to whether the action of the Commission was arbitrary, capricious or unreasonable. Since the action of the Commission was supported by substantial evidence, the court refused to overturn it. (Hubener-Florida)
W70-08003

DAHLSTROM V CITY OF WHITEHALL (MUNICIPAL REGULATION OF INDUSTRIAL SEWAGE DISCHARGE).

14 Mich App 349, 165 NW 2d 443-445 (1969).

Descriptors: *Michigan, *Sewers, *Local governments, *Regulation, Taxes, Legal aspects, Judicial decisions, Legislation, Sewage disposal, Outlets, Sanitary engineering, Municipal wastes, Administration, Planning, Industrial wastes, Industries.

Plaintiff taxpayer brought an action to have an amendment to one of defendant's city ordinances declared unconstitutional and an action for a writ of mandamus to compel the mayor of defendant's city to require Genesco, a large business concern to connect its buildings to the city sewer system. The ordinance before amendment required all residents with sewage to connect their sewer line with a public sewer main if there was one within 100 feet of their property line. The ordinance was amended to require residents to connect if the buildings on their property were within 100 feet of a public sewer line but its buildings were more than 100 feet from a public sewer line. Plaintiff sought to show that the amendment was passed solely to exempt Genesco from connecting with the city sewer system. The trial court held that plaintiff failed to state a cause of action. On appeal, the case was remanded because the trial court failed to state any reasons for its dismissal of the action; consequently, the appellate court could not rule whether or not the trial judge had abused his discretion in dismissing the action. (Barnett-Florida)
W70-08018

MASONITE CORP V STEEDE (RELATIVE RIGHTS TO USE OF WATER--DAMAGES RESULTING FROM WATER POLLUTION).

21 So 2d 463-466 (Miss 1945).

Descriptors: *Mississippi, *Fishkill, *Competing uses, *Damages, Colloids, Effluents, Water pollution sources, Industrial wastes, Pulp wastes, Organic matter, Organic wastes, Path of pollutants, Pollutants, Water pollution effects, Riparian rights, Navigable waters, Relative rights, Riparian waters, Watercourses (Legal), Industrial plants, Riparian waters, Judicial decisions, Legal aspects.

Plaintiff owned a fishing resort which was located on a river into which fed a creek. The creek served as a conveyance for wood fiber effluent from defendant manufacturing plant. Plaintiff sued for loss of business occasioned by said pollution. Plaintiff received judgment at the trial court and defendant appealed. The court held that the plaintiff could recover, if at all, only when it clearly appeared that because of the killing of the fish the profits of plaintiff's business were less than they would have been had the fish not been killed. That consequence was not sufficiently shown so as to warrant a jury verdict for plaintiff; consequently, defendant should have received a directed verdict below. (Price-Florida)
W70-08019

ROSE V SOCONY-VACUUM CORP (NEGLIGENT POLLUTION OF GROUND-WATER).

24 A2d 422-428 (R 1 1942).

Descriptors: *Rhode Island, *Gasoline, *Percolating water, *Wells, Groundwater, Oily water, Oil industry, Water pollution sources, Groundwater movement, Underflow, Artesian wells, Streams, Judicial decisions, Pollution abatement, Potable water, Standards, Water pollution effects, Impaired water quality, Percolation, Penetration, Diffusion, Seepage, Hogs, Storage tanks, Water supply. Identifiers: *Nuisance.

Plaintiff owned farmland on which he raised crops and pigs. Defendant owned a gas station on adjoining land. A break occurred in a pipeline to a tank on defendant's property and over 800,000 gallons of gas escaped into the ground. A year and a half later plaintiff claimed gasoline appeared in the well on his land. In an action for nuisance, plaintiff alleged that the gasoline had percolated in groundwaters to plaintiff's premises, polluting his water

supply and causing the deaths of his pigs. The court found that the defendant was negligent in handling the gasoline. However, in holding for the defendant, the court held the evidence insufficient to establish that gasoline had entered plaintiff's well and stream or was the cause of death of the hogs. Testimony that the water had the taste of gas, or an oily appearance, was not sufficient to prove that the gasoline spilled on defendant's ground had invaded plaintiff's water supply. Moreover, the evidence tended to show that the groundwater slope from defendant's premises did not lead in the direction of plaintiff's well. (Hubener-Florida) W70-08025

OLDERSMA V MUSKEGON DEVELOPMENT CO (POLLUTION OF WATER SUPPLY BY OIL WELL ON ADJOINING LAND).

286 Mich 520, 282 NW 229-231 (1938).

Descriptors: *Michigan, *Oil wastes, *Path of pollutants, *Saline water intrusion, Water pollution, Impaired water quality, Pollutants, Industrial wastes, Groundwater, Water pollution effects, Legal aspects, Judicial decisions, Groundwater movement, Percolating water, Subsurface waters, Diffusion, Gravitational water, Salts, Saline soils, Waste storage, Oil industry, Oil fields, Oil.

Plaintiffs owned a 10 acre tract of farmland on which they raised celery. Defendants operated an oil well on adjoining land and disposed of salt water and other drilling refuse by depositing it into a pit. Plaintiffs brought action for damages alleging that salt deposits which appeared in their land and water supply, and which rendered plaintiffs' farm useless for raising crops, came from defendants' pit. The court found for defendant, holding insufficient plaintiffs' evidence that the salt deposited on their land was due to a subterranean flow of percolating waters containing salt from defendants' pit. The court noted the existence of other wells in the vicinity and concluded that it was impossible to determine that the direction of underground flow led from the area of the defendants' pit to plaintiffs' land. (Hubener-Florida) W70-08026

LIABILITY FOR POLLUTION OF SUBTERRANEAN WATERS.

38 ALR2d 1265-1306 (1954).

Descriptors: *Percolating water, *Water pollution, *Seepage, *Subsurface waters, Prior appropriation, Groundwater, Underground streams, Subsurface runoff, Reasonable use, Damages, Surface runoff, Gasoline, Water pollution sources, Mine water, Oil wastes, Cesspools, Sewage disposal, Domestic wastes, Farm wastes, Municipal wastes, Natural gas, Saline water intrusion, Judicial decisions, Legal aspects, Mine acids, Deep percolation, Water pollution control. Identifiers: Cemeteries.

Considered herein is the liability in damages for, or the enjoining of, the pollution of subterranean waters. A definitional section explains the terms used in the annotation. Various aspects of the rights and liabilities of parties who pollute subterranean or percolating waters form the bulk of this work. Major cases in various jurisdictions are cited as authority for the propositions presented in the body of the text. Generally, the areas considered are: (1) liability for the pollution of waters whether percolating or in subterranean streams; (2) the right to enjoin the continuance of an existing or a possible future pollution; (3) whether liability exists under a charge of negligence or nuisance; (4) the sources of pollution of subterranean waters including refineries, cesspools, privies, oil and gas works, saline intrusion, municipal wastes, manure, dead animals and the like; and (5) injunctions against the establishment of cemeteries if pollution is likely to result. A distinction is made between the American rule of reasonable use and the English rule of absolute ownership. (See also W70-08050 and W70-08051). (Barnett-Florida)

W70-08049

LIABILITY FOR POLLUTION OF SUBTERRANEAN WATERS (THE DISTINCTION BETWEEN SUBTERRANEAN STREAMS AND PERCOLATING WATERS).

38 ALR2d p 1269-1272 (1954)

Descriptors: *Percolating water, *Water pollution, *Seepage, *Subsurface waters, Groundwater, Underground streams, Subsurface runoff, Reasonable use, Prior appropriation, Water pollution sources, Judicial decisions, Legal aspects, Deep percolation.

With regard to liability for their pollution, a clear distinction is made between well-defined subterranean streams and percolating waters. The general rule is that the owner of land abutting on a surface stream may not pollute it to the injury of other riparian owners. This same rule was found applicable in Rhode Island to subterranean streams following a well-defined course, but not so for waters passing by percolation or seepage. In Michigan, an inadvertent and non-negligent pollution of subterranean waters was held to be not actionable. The problem of differentiation between 'flow and seepage' is discussed with regard to liability for pollution of a well by seepage where a contrast was drawn only to impose liability for the flow of certain waters. (See also W70-08049 and W70-08051). (Barnett-Florida) W70-08050

LIABILITY FOR POLLUTION OF SUBTERRANEAN WATERS (NEGLIGENCE FOR THE POLLUTION OF SUBTERRANEAN WATERS OR NUISANCE ACTIONS).

38 ALR2d 1265-1306, p 1285-1290 (1954).

Descriptors: *Percolating water, *Seepage, *Water pollution, *Subsurface waters, Deep percolation, Underground streams, Damages, Oil wells, Water pollution sources, Judicial decisions, Legal aspects, Remedies, Adjudication procedure.

The theories of negligence or nuisance are two grounds for the recovery of damages or for an injunction against the pollution of subterranean streams. Where it is found that the existence of a nuisance caused the pollution of subterranean waters, continuance of the nuisance may be enjoined or damages recovered. Examples of such nuisances are the improper burying of a cow, the improper location of a grave site, or the disposal of sewage so as to cause damage to the health or welfare of society. Two rules are used to impose liability for the pollution of subterranean waters. The American rule states that in the absence of negligence there is no liability if there was legitimate or a reasonable use of the defendant's property. The common law rule is that one must in all events so use his property as not to injure the legal rights of his neighbors. The different jurisdictions that adhere to either one or the other of these rules are listed. (See also W70-08049 and W70-08050). (Barnett-Florida) W70-08051

RACINE V CATHOLIC BISHOP OF CHICAGO (STREAM POLLUTION AS A CONTINUING NUISANCE).

290 111 App 284, 8 NE2d 210-212 (1937).

Descriptors: *Illinois, *Water pollution, *Odor, *Sewage disposal, Streams, Sewage, Riparian rights, Surface waters, Judicial decisions, Legal aspects, Air pollution effects, Water pollution effects, Open channels, Damages, Water pollution sources, Remedies, Relative rights. Identifiers: Nuisance (Continuing).

Plaintiff owned land which he subdivided for the purposes of sale. Defendant erected a seminary in the vicinity of this land. Plaintiff alleged that defendant allowed the sewage from the seminary buildings to flow into a creek that bordered plain-

tiff's land and thus filled the air with noxious odors, destroying plaintiff's business. The trial court directed a verdict for defendant. Plaintiff appealed, alleging a total loss of value in his land. Defendant contended that the alleged nuisance was a continuing nuisance, not a permanent one. The appellate court agreed and held that the pollution of a stream by sewage is a continuing nuisance and that judgments at law are held to afford compensation only for the injury sustained to the time of such judgment and not for future damages. Since the record failed to show a proper allegation of damages by the plaintiffs, the trial court's judgment was affirmed. (Barnett-Florida) W70-08056

SIMON V HUDSON COAL CO (DISCHARGE OF MINE DRAINAGE INTO DITCH).

350 Pa 82, 38 A2d 259-262 (1944).

Descriptors: *Pennsylvania, *Mine water, *Mine drainage, *Discharge (Water), Coal mines, Waste dumps, Mine waster, Ditches, Water release, Effluents, Streamflow, Waste dilution, Conduits, Drainage engineering, Banks, Overflow, Judicial decisions, Legal aspects, Relative rights. Identifiers: *Negligence.

Plaintiff owned property through which ran a ditch that originated in defendant's coal mining area. Defendant discharged drainage water into the ditch at irregular intervals. Following one discharge that increased the depth of water in the ditch by three to six feet, plaintiff's son fell into the ditch and drowned. Plaintiff brought action for damages. Plaintiff contended defendant was negligent in discharging such quantities of water without giving notice to children near the watercourse. The court gave summary judgment for defendant, holding that he had a legal right to discharge water into the stream without any liability to lower owners so long as the banks of the ditch were not overflowed. The defendant was held not negligent for failing to provide warning since the child fell into the water after the level had been raised and since notice of the discharge would not have prevented the child from playing along the ditch. (Hubener-Florida) W70-08060

COMMONWEALTH V DOUGHERTY (POLICY BEHIND LICENSING OF PLUMBERS).

40 A2d 902-904 (Pa 1945).

Descriptors: *Pennsylvania, *Plumbing, *Regulation, *Water quality control, Drainage, Industrial plants, Sewers, Pipes, Construction, Legal aspects, Industrial wastes, Legislation, Public health, Judicial decisions, Permits, Sewage, Drainage effects, Impaired water quality, Water pollution, Engineering structures. Identifiers: Licenses.

Appellant steamfitters tapped a subsidiary water pipe which connected a city water main with tanks located in the factory where appellants were engaged in construction work. From these tanks, which contained mercury cyanide solution, water was drained into a nearby sewer. Appellants were charged and convicted of performing plumbing work without plumbers' licenses, in violation of the state plumbing code. Appellants maintained the statute in question was unconstitutional on the ground that the legislature arbitrarily invaded the personal property rights of the appellants and unnecessarily interfered with their personal liberty under the guise of proper police regulations. The appellate court, however, affirmed the convictions and held that the control of connections with the city's water pipes bears a vital relation to public health since improper connections could lead to a contaminated water supply and inadequate drainage facilities. Consequently, the statute was a valid exercise of the police power. (Finman-Florida) W70-08063

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5G—Water Quality Control

COMMONWEALTH EX REL MCCORMICK V PHILADELPHIA AND R COAL AND IRON CO (POLLUTION OF RIVER BY COAL MINING OPERATION).

347 Pa 602, A2d 19-22 (1943).

Descriptors: *Pennsylvania, *Water pollution, *Coal mine wastes, *Pollution abatement, Rivers, Water pollution sources, Legal aspects, Judicial decisions, Industrial wastes, Sedimentation, Groundwater movement, Dredging, Municipal water, Cities, Relative rights, Mine drainage, Coal mines, Remedies, Mine wastes, Mining, Water supply.
Identifiers: *Injunction.

Defendant company carried on coal mining operations and permitted coal dirt and mine refuse to wash into and pollute a river which was the water supply of plaintiff city. In a prior action in 1907 the court had denied injunctive relief against defendant upon finding that it had begun to impound its wastes. However, the court did grant plaintiff leave to re-apply for any orders necessary to ensure abatement of the pollution. The contaminating mines were subsequently leased to other corporations whose activities caused pollution of the river. Plaintiff, along with other intervening cities, brought action pursuant to the 1907 decisions, sought to join defendant and its lessees, and applied for an injunctive order against the pollution of the river. Plaintiff also asked that defendants be ordered to pay the costs of dredging sediment deposited in the river by defendants' mining operations. The court held that the application for an injunction was not within the terms of the original decree and defendants were entitled to a trial. (Huber-Florida)
W70-08067

APPLICATIONS OF FLUORESCENT TRACER TECHNIQUES IN POLLUTION CONTROL STUDIES,
Beak (T.W.) Consultants Ltd., Montreal (Quebec).
P. L. Timpany.
Pulp and Paper, Vol 71, No 7, T145-T148, 1970. 8 fig, 8 ref.

Descriptors: *Tracers, *Water pollution control, *Dye releases, Fluorometry, Mixing, Evaluation, Water measurement, Dispersion, Time, Pulp and paper industry, Surfaces, Effluents, Analysis, Stratification, Analytical techniques, Tagging, River flow, Flow rates, Dispersion, Data collections, Pulp wastes.
Identifiers: Dilution, Fluorescent dyes, Rhodamine WT, Newfoundland.

Fluorescent tracer techniques are efficient tools in water pollution control studies. Large or small quantities of water may be tagged by the techniques outlined to study water distribution under any flow or mixing conditions. All fluorescent tracers are temperature dependent and must be calibrated and analyzed at a constant temperature or adjusted to calibrated temperature. Rhodamine W T (Dupont) is recommended for most long term studies of surface waters or flow studies of concentrated waste effluents occurring in 5-day pulp and paper mill aerated lagoons. Valuable information can be obtained relatively easily for flow rates, time-of-travel, dispersion, dilution, mixing, stratification, short-circuiting, and stagnant volumes. It is especially significant in evaluating the effects of spills or accidental dumps of soluble pollutants on water users downstream from a particular outfall. The field of fluorometric analysis makes it possible to measure accurately and analyze natural and industrial hydraulic processes including those of protection against shock loading, effects of hydraulic short-circuiting or stratification, aerator mixing capabilities, and volumetric measurement of stagnant or dead areas. (Jones-Wisconsin)
W70-08100

SIMULATION MODELING OF THERMAL EFFLUENT IN AN IRRIGATION SYSTEM,
Battelle Memorial Inst., Richland, Wash. Pacific Northwest Labs.

D. E. Peterson, and R. T. Jaske.
AEC Research and Development Report, BNWL-1277, UC-70, Pacific Northwest Laboratories, Richland, Jan. 1970. 21 p, 11 fig.

Descriptors: *Temperature, *Canals, *Irrigation, Heat transfer, Meteorological data, Evaporation, Conduction, Radiation, Water pollution control, *Simulation.

Identifiers: *Thermal effluent, COLHEAT simulation system, Advection heat, Flow records.

Simulations of hourly average water temperatures along a 40 mile reach of the Phelps county canal of south-central Nebraska were carried out by utilizing moving means of hourly regional weather data as input to the COLHEAT computer program. The COLHEAT simulation model applied a heat budget to a given section of a river or canal. The water temperature for a section Tw is determined. The simulation of the addition of a 500% increase in heat rejection to the canal system indicated a large potential sink capability for future expansion of the system without extensive modifications of the simulated thermal history. The computed rates of heat transfer from the canal indicate overall coefficients as high as 700 BTU/ (day) (ft²) (deg F) compared to 100-200 BTU/ (day) (ft²) (deg F) for lakes and ponds. Neither benefits nor liabilities to agriculture resulted from water temperature modification. (Upadhyaya-Vanderbilt)
W70-08117

MASONITE CORP V DENNIS (BURDEN OF PROOF FOR POLLUTION DAMAGE).

168 So 613-616 (Miss 1936).

Descriptors: *Mississippi, *Riparian land, *Industrial wastes, *Wood wastes, Water pollution, Public health, Pollutants, Pollutant identification, Wastes, Effluents, Water pollution sources, Industrial plants, Judicial decisions, Legal aspects, Remedies, Regulation, Depreciation, Productivity, Fibers (Plant), Upstream, Discharge (Water), Damages, Deposition (Sediments), Fish kill, Property values.

Defendant's manufacturing plant discharged waste products, consisting primarily of wood fiber, at a point fifty miles upstream from plaintiff's land. Plaintiff alleged that as a result of such discharge a sediment, as well as large numbers of dead fish, were deposited on his land, thereby adversely affecting the land's productivity. Plaintiff brought action for damages for the depreciation in value of the land. Defendant maintained that the effluent from its plant alone could not have destroyed animal life in the stream but would have had to be joined by effluents from other nearby sources. Also, although defendant discharged a million or more gallons of water and wood fiber into the stream daily, the amount of wood fiber was infinitesimal as compared to the immense volume of water discharged. The court took notice of the fact that polluted water would purify itself within a reasonably short distance, and that fish within a short distance downstream from defendant's plant were not normally destroyed by the effluent therefrom. The court concluded that since there was also a great distance from defendant's plant to plaintiff's land, there was no evidence to establish defendant's liability to plaintiff. (Finman-Florida)
W70-08118

COTTON SLASHING WITH SYNTHETIC COMPOUNDS AS A MEANS TOWARD POLLUTION ABATEMENT,
Crompton-Shenandoah Co., Inc., Waynesboro, Va. Duane W. Snyder.

American Dyestuff Reporter, Vol 44, No 12, p 382-384, 1955. 2 ref, 2 fig, 4 tab.

Descriptors: Waste water treatment, *Water pollution control, *Cotton.

Identifiers: *Desizing wastes, *Dyehouse wastes, *Substitution, Carboxymethyl-cellulose, Slashing Textile mill wastes, Desizing.

Desizing and dyeing wastes contribute about 89% of the BOD coming from plants that discharge waste from wet processes directly into small streams. Process substitution can remove about 59% of the BOD and eliminate the need for a treatment plant without greatly changing net operating costs. High-purity carboxymethylcellulose is practical as a desizing chemical; lower solids add-on reduces slashing costs, and water requirements for good desizing are lowered by 50%. Substituting mineral acids for acetic acid lowers dye-wastes pollution. The extent of substitution in the slashing formula determines the degree of BOD reduction (Sheffield-North Carolina State Univ)
W70-08142

06. WATER RESOURCES PLANNING

6A. Techniques of Planning

THE DEVELOPMENT OF A MODEL TO EVALUATE HYDROLOGIC RISK IN A WATER RESOURCE SYSTEM,
Battelle Memorial Inst., Richland, Wash.; and Texas A and M Univ., College Station.

William L. Bathke, and R. J. Freund.
Water Resources Bulletin, Vol 5, No 1, p 53-61, March 1969. 9 p, 15 ref, 3 fig.

Descriptors: *Economic analysis, *Risks, *Water supply, *Irrigation design, *Simulation analysis, *Probability, Prices, Floods, Benefits, Optimization, Reservoir, Water inflow, Hydrologic aspects, Computers, Economics, Watersheds, Model studies, Storage capacity, Stream flow, Costs, Economic evaluation, Water resource planning, Operations research, Dynamic programming, Irrigation efficiency.

Identifiers: *Irrigation development, *Surface technology, Operational hydrology, Hydrologic risks.

A technique is described for analyzing a water resource system whose inflow is highly variable. The use of this technique requires not only that a mathematical model be developed of the physical, hydrological and economic characteristics of the water resource system under study, but also that there be an economic evaluation of the benefits of the system, including full and partial water deliveries for irrigation development. Data from a watershed in the South Concho River, Texas was used. A region of tolerable water shortages was computed and a three-dimensional economic loss function derived. A response surface of net benefit was then fitted to the resulting net benefits of the various design combinations. Standard response surface technology was used to derive the optimum combinations for a desired irrigation development level. (Murphy-Rutgers)
W70-07738

SCHEDULING IRRIGATIONS WITH COMPUTERS,
Agricultural Research Service, Kimberly, Idaho. Snake River Research Center. Marvin E. Jensen.
Journal of Soil and Water Conservation Vol 29, No 5, p 193-195, September-October 1969. 3 p.

Descriptors: *Irrigation, *Cost, *Computers, *Management, Climate, Statistics, Value, Data collections, Rainfall, Soil analysis, Precipitation, Farming, Optimization, Evaporation, Programs, Data processing.

Identifiers: *Irrigation scheduling, *Time sharing.

The author seeks to show how irrigation scheduling using climate-crop-soil data and computers can facilitate the tedious computations usually accompanied by field observations. This service, which in-

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udes the field work of experienced personnel, is own to be an economically justified management service which increases the management skills of the farmer at a reasonable cost. The background of development is traced and the basic principles involved are explained. The cost of the service is found to be a hindrance to its adaptation on small farms but posing no problem for large acreages. (Loeb-Rutgers)
W70-07739

THE ELEMENTS OF INPUT-OUTPUT ANALYSIS,
West Virginia Univ., Morgantown. Regional Research Inst.
William H. Miernyk.
New York, Random House, 1965. 156 p.

Descriptors: *Input-output analysis, Leontief models, Statistical methods, Economic, Industries, Forecasting, Regional analysis.
Identifiers: *Econometrics, *Input-output table, transaction, Sectors, Technical coefficients, Purchases, Stability conditions, Multiplier analysis, Employment multiplier, Interregional analysis, Development.

The author presents the essentials of input-output analysis in nonmathematical terms, although a certain amount of arithmetic is used to illustrate various steps in the analysis. The book is concerned only with input-output analysis rather than with the statistical problems involved in the construction of an input-output table. The last chapter of the book discusses the rudiments of input-output mathematics. Most of this book deals with a static, open input-output model. This model is the type upon which the 1947 tables for the United States were based. Input-output analysis has been used extensively in the water area. For example, such a technique has been used in an analysis of western water resource development. In light of its promising uses in the water area, this book will be of value to the water researcher unfamiliar with input-output analysis. (Loeb-Rutgers)
W70-07742

PECUNIARY AND TECHNOLOGICAL EXTERNALITY, FACTOR RENTS, AND SOCIAL COSTS,
Washington Univ., Seattle.
Dean A. Worcester, Jr.
American Economic Review, Vol 59, No 5, p 873-85, December 1969. 4 fig, 1 tab, 23 ref.

Descriptors: Rent, Welfare, Prices, Alternative costs, Marginal costs, Average costs, Competition, Demand, Monopoly.
Identifiers: *Pecuniary externality, *Technological externality, Externalities, Factor rents, Social costs, Marginal products, Opportunity cost, Production function, Monopsony.

In this paper the author considers the effects of pecuniary and technological externalities in a neoclassical analysis. The author concludes that all external effects are found in principle to be reducible by correct input pricing to economies or diseconomies. This holds for separable and nonseparable externalities in production and for externalities viewed either in terms of specific firms or among industries. Different industry structures produce optimal allocation either for technological or for pecuniary externalities if the externalities are internal to an industry and the firms therein use the same factor proportions. When these conditions do not hold, only competitive structures and pecuniary externalities suffice to produce an optimum in the absence of complicated combinations of taxes and subsidies which require a wealth of accurate detailed data. This article may prove to be of interest to the water researcher investigating the effects of externalities of water production. (Loeb-Rutgers)
W70-07743

MANAGEMENT'S NEW ROLE,
New York Univ., N.Y. Graduate School of Business Administration.
Peter F. Drucker.
Harvard Business Review, p 49-54, November-December 1969.

Descriptors: *Management.
Identifiers: Social responsibility, Science, Discipline, Economic development, Entrepreneurial innovation, Humanity.

The author reviews five assumptions that may have formed the foundation of the theory and practice of management in the last half century. These assumptions deal with the scope, the task, the position and the nature of management. These assumptions were: (1) Only business has 'social responsibility.' (2) Entrepreneurship and innovation lie outside the management scope. (3) It is management's task to make the manual worker productive. (4) Management is a 'science' or at least a 'discipline.' (5) Management is the result of economic development. The author argues that many of these assumptions have become obsolete and formulates five new assumptions which correspond to the management realities of today. These new assumptions are (1) all institutions, including business, are accountable for the 'quality of life.' (2) Entrepreneurial innovation will become the core of management. (3) It is management's task to make knowledge more productive. (4) Management will have to be considered as both a 'science' and a 'humanity.' (5) Economic and social development are the result of management. The author contends that these new assumptions are better guides to effective management. This discussion would be helpful to the water manager who must use science and the natural environment in order to achieve water needs and maintain the quality of life. (Loeb-Rutgers)
W70-07745

DYNAMIC PROGRAMMING OF ECONOMIC DECISIONS,
Martin J. Beckmann.
New York, Springer-Verlag Inc, 1968. 143 p.

Descriptors: *Dynamic programming, Mathematical studies, Economics, Operations research, Technology, Sequence, Risks, Linear programming, Stability, Resource allocation, Constraints.
Identifiers: *Economic decisions, Mathematical theory, Discrete sequences, Continuous sequences, Continuous decision variables, Discrete decision variables, Certainty, Finite alternatives, Optimality, Value function, Machine care, Inventory control, Exponential weighting, Turnpike theorem, Sequential programming.

Dynamic programming is the analysis of multistage decision in the sequential mode. It is now widely recognized as a tool of versatility and power, and is applied to an increasing extent in all phases of economic analysis, operations research, technology, and also in mathematical theory itself. In this monograph the reader is introduced to the basic ideas of dynamic programming. An attempt is made to show the breadth of this method by a careful exposition of its principles followed by some typical applications to economic analysis, operations research and decisions making in general. Some effort has been made to give a systematic exposition of the various possibilities: discrete and continuous sequences; discrete and continuous decision variables; certainty, risk, and uncertainty. Dynamic programming has proven to be quite applicable in the water area for solving such problems as the optimal sequencing of water supply projects. (Loeb-Rutgers)
W70-07746

ON THE SOCIAL RATE OF DISCOUNT: COMMENT III,
California Univ., Berkeley.
Carl Landauer.

American Economic Review, Vol 59, No 5, p 917-918, December 1969. 6 ref.

Descriptors: Demand, Risks, Time.
Identifiers: *Social rate of discount, Time preference, Mission, Irreversibilities, Disproduct.

The author provides an additional argument of why the search for a unitary, optimal rate of social discount is futile. The author considers a factor which in historically important instances has increased the difference between private and public time preference in the minds of at least some members of a community. This factor is that of a sense of national mission requiring heavy present sacrifice for the sake of the future. The Tullock objection to this is discussed (i.e. that the next generation will be wealthier than us) as well as the counterarguments to this such as the impossibility of restoring the fertility of the soil or the beauty of the land once they have been destroyed. The author points out that some public investments have a close relationship to our private fortunes while others have a much looser relationship to our personal lives. These arguments would be directly applicable to the water area where a sense of national mission may be influential as a catalyst for water project investment decisions. (Loeb-Rutgers)
W70-07747

A GEOMETRIC TREATMENT OF AVERCH-JOHNSON'S BEHAVIOR OF THE FIRM MODEL,
Bell Telephone Lab., Inc.
E. E. Zajac.
American Economic Review Vol LX, No 1, p 117-125, March 1970.

Descriptors: *Model studies, *Cost minimization, *Rate of return, Capital, Profits, Management, Resource allocation, Economic efficiency, Prices, Technology.
Identifiers: *Firm regulation, *Social costs, Geometric analysis, Stockholders equity, Rate regulation.

The Averch-Johnson model of the regulated firm concluded that a profit-maximizing firm, regulated on fair rate of return, operates inefficiently in the sense that social cost is not minimized at the output selected and that the firm adjusts to the regulatory constraint by substituting capital for labor. Thus, regulated firms are driven to socially undesirable operations. This article gives a geometric analysis of the model and discusses its conclusions. The author examines the behavior of the firm and its regulators and replaces the profit maximization hypothesis with that of maximizing rate of return on equity. An attempt is also made to model the effect of the labor constraints to which the firm is subject. The last section examines the rate base expansion by acquisition of nonproductive capital in order to show how it differs from the Averch-Johnson effect. The article has particular relevance for the water resource area where water utilities are subject to the regulatory process. (Murphy-Rutgers)
W70-07748

STRATEGY FOR FINANCIAL EMERGENCIES,
Harvard Univ., Boston, Mass. Graduate School of Business Administration.
Gordon Donaldson.
Harvard Business Review, p 67-79, Nov-Dec 1969. 2 charts, 1 ref.

Descriptors: *Risks, Financing, Model studies, Management, Computers.
Identifiers: *Financial emergencies, *Contingency planning, Contingency analysis, Inventory, Reserves, Strategy, Information system, Cash-flow computer model, Financial mobility.

Uncertainty has always been a part of business experience. However, current planning techniques and the philosophy of management by goals and objectives seem insensitive to unexpected change.

Field 06—WATER RESOURCES PLANNING

Group 6A—Techniques of Planning

With business uncertainties increasing as the nation attempts to readjust its commitments abroad and solve major social and economic problems at home, the need for formal planning to cope with unexpected deficit in funds flow becomes important. In this article the author suggests three steps in a strategy for dealing with financial emergencies around which a new approach to the problem can be organized. The first step is to provide the company with an information system capable of analyzing data about the likely course of events in the future. The second step in contingency planning is the preparation of inventory of resources of financial mobility. The third step is the formulation of a strategy for dealing with the unknown. This approach might be quite helpful to the water planner whose investment decisions are often beset by the uncertainties of the political system. (Loeb-Rutgers)

W70-07749

ON THE SOCIAL RATE OF DISCOUNT: COMMENT V,

Queen's Univ., Kingston (Ontario).

Dan Usher.

American Economic Review, Vol 59, No 5, p 925-929, Dec 1969. 1 fig, 2 ref.

Descriptors: Interest, Risks, Taxes, Discount rate, Welfare.

Identifiers: *Social rate of discount, Consumption, Time preference, Opportunity cost.

Referring to Baumol's recent paper, the author contends that the choice of discount rate cannot be literally indeterminate if the correct rate can be found using the theory of the second best. Even when the rate of time preferences differs from the rate of opportunity cost in the private sector, an optimal rate of discount for the public sector is implied by the rules for maximizing the welfare of the community in the choice of public and private goods. Using the method developed by Lipsey and Lancaster the author shows how to choose the interest rate on government projects and proves that, under quite general assumptions, the appropriate interest rate on government projects lies between the rate of time preference and the rate of opportunity cost between present and future consumption in the private sector. This may prove valuable to the water researcher in light of the impact of interest rates on his investment decisions. (Loeb-Rutgers)

W70-07751

THE EXISTENCE OF AN OPTIMAL ECONOMIC POLICY,

California Univ., Berkeley; and Iowa State Univ., Ames.

T. Krishna Kumar.

Econometrica, Vol 37, No 4, p 600-610, Oct 1969. 21 ref.

Descriptors: Mathematical studies, Mathematical models, Economics, Linear programming.

Identifiers: *Optimal economic policy, Optimal policy, Planning horizon, Control variables, State variables, Optimal control, Helby's Theorem.

In its most general form an optimal economic policy is characterized as an optimal choice among alternative feasible time paths in transforming the economy from a given initial state to a desired final state at the end of planning horizon. Since the mathematical description of the economy consists of variables, some of which are control variables, while the rest are the controlled variables or the state variables, the problem is analogous to the structure of optimal control policies. The question of the existence of optimal economic policies in dynamic models posed recently by Chakravarty and Yaari is examined here within a more general framework. In the particular case of a linear model, the problem can be shown to be equivalent to a continuous (or infinite) linear programming problem. The existence of optimal policy in this use is equivalent to the duality theorem for a continu-

ous linear programming problem. This analysis would prove applicable to economic policy problems in the water area where a policy maker's welfare function, dependent upon the time paths of some specified state variables and instrument variables (constraints), is to be maximized. (Loeb-Rutgers)

W70-07752

ESTIMATION OF THE LINEAR EXPENDITURE SYSTEM,

Pennsylvania Univ., Philadelphia.

Robert A. Pollak, and Terence J. Wales.

Econometrica, Vol 37, No 4, p 611-628, Oct 1969. 4 tab, 3 append.

Descriptors: *Estimating, Expenditures, Demand, Economics, Statistical methods, Prices.

Identifiers: *Estimation, *Linear expenditure system, Maximum likelihood estimates, Consumption, Dynamic specification, Stochastic specification.

In this paper the authors estimate a complete system of demand equations making full use of the restrictions implied by economic theory. The theoretical model is based on the Klein-Rubin linear expenditure system which was first estimated by Stone. Primary emphasis is placed on maximum likelihood estimates obtained using annual time series observations of prices and per capita consumption for the U.S. economy in the period 1948-1965. The plan of the paper is as follows: Section 1 begins with a discussion of the problems involved in making systematic use of economic theory to estimate demand functions; this is followed by a brief description of the linear expenditure system and a discussion of the specification of its dynamic and stochastic structure. In section 2 three methods of estimating the linear expenditure system are described, including the maximum likelihood procedure which the authors believe to be most appropriate. The results are reported in Section 3 and conclusions in Section 4. This article would prove applicable to the water area when using econometric methods to estimate water demand equations.

W70-07755

DESIGN AND CONSTRUCTION OF THE WORLD'S LARGEST FLASH TYPE DESALTING PLANT AT TIJUANA, MEXICO,

For primary bibliographic entry see Field 03A.

W70-07765

UTILIZATION OF PHYSICAL AND MATHEMATICAL MODELS IN MARINE WATER RESOURCES RESEARCH, PLANNING AND MANAGEMENT,

Virginia Inst. of Marine Science, Gloucester Point.

For primary bibliographic entry see Field 02L.

W70-07801

METHODS SYSTEMIZATION MANUAL: PREPARATION OF HYDROLOGIC ENGINEERING COMPUTER PROGRAMS.

Corps of Engineers, Sacramento, Calif. Hydrologic Engineering Center.

For primary bibliographic entry see Field 08B.

W70-07853

ENGINEER VERSUS COMPUTER - A STRATEGY OF PERSUASION,

California State Div. of Highways, Sacramento.

Earl Rogers.

Proceedings, American Society of Civil Engineers, Journal of Professional Activities, Vol 95, No PPI, Proc Paper 6654, p 9-15, July 1969. 7 p.

Descriptors: *Computers, *Engineers, Attitudes, Motivation.

Identifiers: Persuasion, Programmers.

Although engineering staffs have daily exposure to computers, little thought process is devoted to its

imaginative or innovative use. Specific points of resistance, reasons why the growth of computer installation can induce or prolong resistance, and suggested ways to dissolve resistance are cited. Points of resistance included the engineers satisfaction in doing their own calculations, the time factor, limits of computer programs and their complexity. One of the problems of growth included the question of using engineer-programmers or engineer programmers. It was stated that engineering organizations should place an engineer in charge of its computer installation. In this case engineers must be educated as to the worth of their computer and it must be kept close to them. A three-man team approach was suggested for development of a new engineering system. It consisted of the engineer-use, the engineer-computer specialist and the engineering computer programmer. As an example, the development of a highway drainage analysis system was described. (Kriss-Cornell) W70-07855

PHOTOSYNTHESIS AND OXYGEN BALANCE IN STREAMS,

Manhattan Coll., Bronx, N.Y. Dept. of Civil En-

gineering.

For primary bibliographic entry see Field 05G.

W70-07857

ON OPTIMIZATION METHODS FOR BRANCHING MULTISTAGE WATER RESOURCE SYSTEMS,

Montana State Univ., Bozeman.

Oscar R. Burt.

Water Resources Research, Vol 6, No 1, p 345-346, Feb 1970. 2 p, 8 ref.

Descriptors: *Optimization, *Linear programming, *Dynamic programming, *Constraints, *Water resources.

Identifiers: *Nonlinear programming, Branching.

Presentation of linear and nonlinear programming models and dynamic programming models for application to branching multistate systems was the primary objective of the letter written in reference to a recent paper by Meier and Beightler and subsequent discussions between Loucks and Meier and Beightler. The positions taken by the men mentioned ruled out the use of linear programming (and nonlinear programming) jointly with dynamic programming within the same optimization scheme. It was noted that the class of problems considered by Meier and Beightler had the following properties: (1) additivity in the criterion function, (2) linearity in the constraints, and (3) essentially the so-called angular form in the constraint equations. It seemed surprising that the Dantzig-Wolfe decomposition was not mentioned by Loucks or Meier and Beightler, since it was so applicable to problems with the three properties listed. The first two properties were ruled out by the author and the third, dynamic programming was considered. It was stated that recurrence relation of dynamic programming permits recursive optimization stage by stage, and there is nothing to prevent the use of linear or nonlinear programming in the optimization of each stage. The virtues and advantages of the method described were apparent to the author. (Kriss-Cornell) W70-07859

OPTIMIZATION OF BASIC PARAMETERS OF THERMAL DESALTING PLANTS WITH ADIABATIC EVAPORATION,

For primary bibliographic entry see Field 03A.

W70-07860

OPTIMIZATION OF A REVERSE OSMOSIS SYSTEM USING NONLINEAR PROGRAMMING,

California Univ., Los Angeles. Graduate School of

Business Administration.

G. B. Hatfield, and Glenn W. Graves.

Desalination, Vol 7, No 2, p 147-177, Feb 1970. 31 p, 2 fig, 6 tab, 18 ref, append.

Evaluation Process—Group 6B

Descriptors: *Optimization, *Mathematical models, *Desalination, Brackish water, *Reverse osmosis, Computer programs, Costs.
Identifiers: *Nonlinear programming, *Coalinga Pilot Plant, Parameters.

mathematical model of a large tube reverse osmosis system for desalination of brackish water was developed. The system was said to be similar to the tubular assemblies of the Coalinga Pilot Plant described. Performance equations of a tubular assembly developed by Rosenfeld and Lieb were presented. Then a mathematical model characterizing a series of assemblies where the output from the first assembly is the input to the second, etc. was built. The parameters of pressure, flow rate, salt concentration, tube length and diameter, and brine temperature characterizing the Coalinga plant were used with the performance equations to determine the product flux and the product salt concentration. The results were compared with actual operating curves from the Coalinga Plant to determine the validity of the mathematical model and the performance equations. A nonlinear programming problem was formulated with the objective of maximizing product flux and determining the optimal arrangement of assemblies with respect to fabrication temperature and was run on the IBM System 360 Model 75 computer at UCLA. The solution of the problem pointed out that by using modern computing machines and optimization techniques substantial gains can be made in reducing the size of reverse osmosis systems and thus reducing the cost of the water produced. (Kriss-Cornell)
W70-07861

SCIENTIFIC METHOD - A TRIAD,
Miami Univ., Coral Gables, Fla.

Murray I. Mantell.

Proceedings, American Society of Civil Engineers, Journal of Professional Activities, Vol 95, No PP1, Proc Paper 6676, p 47-53, July 1969. 7 p, 3 fig, 1 ab, 5 ref, append.

Descriptors: *Systems analysis, *Design, *Operations research, *Engineering.
Identifiers: *Scientific method, Basic research, Applied research, *Flow charts.

The thesis that the scientific method may generally be applied to all types of problems, and that where the method appears inapplicable it appears thus because of application of the wrong pattern of the scientific method's triad of patterns of problem solving, was presented. The three patterns within the scientific method were entitled: (1) Basic Research; (2) Applied Research; and (3) Systems Approach and details of each were presented. A flow chart sequence of steps involved in an efficient approach to basic research was shown. The key step shown is the process of induction in which a theory or principle is derived. A second flow chart demonstrated the pattern of problem solving in applied research. The most significant difference between patterns of problem solving in basic and applied research was said to be in the types of assumptions used. For the pattern characteristically used in solving individual problems directly applicable to man's needs and desires, the systems approach was described in a third flow chart. The major differences between all three patterns of problem solving were summarized. (Kriss-Cornell)
W70-07863

COMPUTER MODELING TECHNIQUES FOR ENVIRONMENTAL SYSTEMS,
Polytechnic Inst. of Brooklyn, N.Y. Center for Urban Environmental Studies.

Paul R. DeCicco, and Richard Slutza.
New York State Science and Technology Foundation Report, Dec 1969. 172 p, 63 fig, 7 ref. Grant No SSF (8)-1.

Descriptors: *Computer programs, *Data processing, *Input-output analysis, *Waste water treatment, *Sewers, Design, Costs.

Identifiers: *Heuristic networks, Demographics, Topographics, Potential links, Digitizer, Nassau County.

The principal effort of the study was the development of a computerized heuristic technique for the layout of waste water collection systems. The general approach was predicted on the availability of a series of computer programs for testing by designing and costing the heuristic networks developed. A system was constructed for the consideration of demographic, topographic, and service characteristic information in the generation of 'Potential Links' for the area to be designed. The trial network was then developed by establishing each final link in accordance with priority ratings based on a number of weighted criteria. The system contained 32 routines including five major routines for defining the network, and ten special routines for determining the elevation at any point, the assignment of street code information, rating of how well each link satisfied the service requirement, and for performing a number of other functions which convert the trial network into a practical layout. The remaining routines were for sorting and ordering data, for printing tables and for performing special operations, such as reversing flow direction of a link, correcting service ratings, and printing error and other messages. A system was developed using an electronic x-y digitizer for input data. The possible use of mark-sense input techniques was also considered and described. A detailed design and cost estimating program and an evaluation of the heuristic network procedure based upon the output program was given. The street model used was in Nassau County. (Kriss-Cornell)
W70-07864

OPTIMUM OPERATION OF DESALTING PLANTS AS A SUPPLEMENTAL SOURCE OF SAFE YIELD,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 03A.
W70-07865**SIMULATION AND HYDROLOGIC RESPONSE OF A DRAINAGE NET OF A SMALL AGRICULTURAL DRAINAGE BASIN.**
Uttar Pradesh Agricultural Univ., Naini Tal (India); and Illinois Univ., Urbana.
For primary bibliographic entry see Field 04A.
W70-07869**PRINCIPLES GOVERNING THE DESIGN AND CONSTRUCTION OF ECONOMIC REVETMENTS FOR PROTECTING THE BANKS OF RIVERS AND CANALS FOR OCEAN - AND INLAND NAVIGATION,**
Ingenieur general des Ponts et Chaussees, Paris (France).
V. Le Gorgeu.

Perma Int Asso of Navigation Congr, XXIInd Int Navigation Congr, Sect 1, Subj 6, Inland Navigation, Paris, 1969, p 1-8.

Descriptors: *Retaining walls, *Construction costs, Bank stability, Canal design, Navigable waters, Grading, Dredging, Laterals, Construction materials, Canals.

General Report on Section 1, Subject 6, Inland Navigation, on the principles governing the design and construction of economic revetments for protecting the banks of rivers and canals for ocean and inland navigation. The Report includes summaries of articles written by Germany, Belgium, France, Italy, Japan, Netherlands, Poland, United Kingdom, U.S.A., and the Suez Canal (International Commission on Irrigation and Drainage). Abstracts of these articles are forwarded separately. Two copies of the General Report are given, one written in French and one written in English. (Grossman-Rutgers)
W70-07946

6B. Evaluation Process**SOCIAL AND ECONOMIC IMPACT OF SNOW SURVEY DATA,**
Soil Conservation Service, Boise, Idaho.
Morlan W. Nelson.

Proceedings 37th Annual Meeting of Western Snow Conference, April 15-17, 1969, Salt Lake City, Utah; printed by Colorado State University, Fort Collins, p 83-87, 1969. 5 p, 2 fig, 5 ref.

Descriptors: *Snow surveys, *Social aspects, *Economics, *Cost-benefit analysis, Flood control, Water pollution control, Recreation, Reservoir operation, Water management (Applied), Planning, Economic impact, Social impact.
Identifiers: Snow survey data.

In general, there is a social and economic impact on many businesses or activities in the western United States from basic snow survey and water supply forecast data. However, in all cases, these data exert their influence through more efficient management of our basic resources of water and soil. Future generations will be more dependent upon the snow survey data than we are today, and upon the improvements that will be made through telemetry and new electronic equipment. A conservative estimate of the economic value of water supply forecasts to agriculture alone, excluding all Bureau of Reclamation projects, is responsible for a new increase in farm income of somewhere between \$32,000,000 and \$65,000,000 per year. The total economic and social impact is far greater than the primary farm income benefit. (Knapp-USGS)
W70-07676

CONFLICTS IN WATER USE AND REGIONAL PLANNING IMPLICATIONS,
Washington Univ., Seattle.
Ronald R. Boyce.
Edited by M. E. Marts, Regional Development and the Wabash Basin, p 145-156, University of Illinois Press, Urbana, 1964.

Descriptors: *Water utilization, Regions, Water resources development, Economics, Pacific Northwest U.S.
Identifiers: *Conflicts, Shortages.

Water resource developments, comprising elements of private and public fiscal, economic, social, and political policy, are a fertile field for the generation of conflicts. This discussion provides examples of conflict situations and indicates some implications for planning. The discussion is focused on the Pacific Northwest where large and varied water resources support activities of vital importance in a limited regional economy: irrigation, hydropower production, fisheries, inland navigation, and recreation. Conflicts arise not so much because of shortages, but because of competing proposals for the use of important resources, or because of development proposals being opposed by those who see advantages in maintaining the status quo. (Loeb-Rutgers)
W70-07737

THE ECONOMICS OF PRODUCTION FROM NATURAL RESOURCES: NOTE,
Montana State Univ., Bozeman.
Ronald G. Cummings, and Oscar R. Burt.
American Economic Review, Vol 59, No 5, p 985-990, December 1969. 9 ref, 1 append.

Descriptors: *Natural resources, Economics, Resources, Investment, Capital, Mining, Profit.
Identifiers: *Production, Exhaustible resources, Replenishable resources.

The authors discuss a recent article by Vernon Smith which attempts to provide "...a unified theory of production from natural resources" encompassing production from exhaustible, as well as replenishable, resources. The authors question the general applicability of Smith's model with

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reference to the optimum rate of production from exhaustible resources, and therefore his description of the optimum rate of investment in these industries. The purpose of this paper is first to discuss the limited nature of Smith's results concerning production and investment within the context of exhaustible resources, and secondly to present a model that retains Smith's emphasis on the interrelationship of capital and resource extraction, but conforms to the established theory concerning the economics of exhaustible resources. The model presented focuses on the individual firm and may prove to be applicable to the water resource area. (Loeb-Rutgers)

W70-07744

A COMPARISON OF BARTEN'S ESTIMATED DEMAND ELASTICITIES--WITH THOSE OBTAINED USING FRISCH'S METHOD,

California Univ., Los Angeles.

Robert Ayanian.

Econometrica, Vol 37, No 1, p 79-94, Jan 1969. 4 fig, 4 tab.

Descriptors: *Elasticity of demand, Demand, Marginal utility, Prices, Estimating, Statistical methods, Regression analysis.

Identifiers: *Frisch's method, Income elasticity, Direct elasticity, Cross elasticity, Want-independent goods.

From the knowledge of budget proportions, income elasticities, and income elasticity of the marginal utility of income, point estimates of all direct and cross demand elasticities with respect to price may be easily computed for want-independent goods. Estimates obtained in this manner are without standard errors. One method of ascertaining the reliability of such estimates is to compare them, under varying conditions, with corresponding estimates whose standard errors are known. Ragner Frisch has presented a method for computing all direct and cross demand elasticities under conditions of want-independence. Barten, using data for the Netherlands and the United Kingdom and assuming almost additive preferences, has obtained a complete set of direct and cross demand elasticities for a fourteen sector model. This paper gives the results of the application of Frisch's procedure to Barten's data to obtain a complete set of demand elasticities which are then compared to those presented by Barten. The author concludes that Frisch's method for the determination of all direct and cross demand elasticities should be of great value in those areas where little price data is available. This method, although complex, would be applicable in estimating water demand functions.

W70-07750

COMPETITION AND THE REGULATORY PROCESS,

James W. Karber.

The Quarterly Review of Economics and Business, Vol 9, No 3, p 57-64, Autumn 1969. 8 p.

Descriptors: *Public utilities, *Regulation, *Competition, Investment, Technology, Gross National Product, Economics, Costs, Prices, Transportation, Interest rate, Financing, Profits, Productivity, Efficiencies.

Identifiers: *Rate of return, *Promotion, Diversification.

In most regulated industries the issues of competition and promotional practices are being raised with increasing frequency. There are efforts to make greater competition a supplement to regulation. It is often pointed out that competition brings increased productivity and better resource allocation. The article shows, however, that the results of regulation in the U.S. have been good. Public utilities, which would include water utilities, are in the midst of a period of great technological change which presents problems for regulators. It is necessary that competitive forces be properly directed if they are to be useful. Competition and regulation

are terms having little meaning in the abstract and must be applied to real regulatory situations if their values are to be tested. The approach to be used should be guided by society's individual and social goals. The importance of the regulatory process in many water resource projects make this a valuable article for the water resource planner. (Murphy-Rutgers)

W70-07753

DESIGN AND OPERATION OF LARGE DESALTING PLANTS,

For primary bibliographic entry see Field 03A.

W70-07854

ON OPTIMIZATION METHODS FOR BRANCHING MULTISTAGE WATER RESOURCE SYSTEMS,

Montana State Univ., Bozeman.

For primary bibliographic entry see Field 06A.

W70-07859

NOTE ON EVALUATIONS OF R/S FOR FRACTIONAL NOISES AND GEOPHYSICAL RECORDS,

IBM Watson Research Center, Yorktown Heights, N.Y.

Murad Taqqu.

Water Resources Research, Vol 6, No 1, p 349-350, Feb 1970. 2 p, 2 fig, 4 ref.

Descriptors: *Computer programs, *Statistics, Hydrologic aspects, Mathematical models.

Identifiers: Mistake, Fractional noises, Geophysical records.

A mistake in the computer program evaluating the statistic R/S affecting the figures in the papers of Mandelbrot and Wallis (Water Resources Research Vol 5, No 1:228-267, 1969; Vol 5, No 2:321-340, 1969; Vol 5, No. 4:917-920, 1969; Vol 5, No. 5:967-968, 1969) was found. Once the mistake was corrected, the self-similar model of hydrologic time series turned out better than what was thought from the above mentioned papers. The mistake had an important effect only when the lag s was small. Corrected graphs were shown of R/S for a sample of fractional Gaussian noise and a hydrologic record of annual tree ring indices for a bristlecone pine from White Mountain, California. The mistake was due to a discrepancy between the mathematical definitions of the sequential range R and the actual formula used in the program to compute this R. In copies of the R/S program distributed by SHARE the above mentioned error has been corrected. (Kriss-Cornell)

W70-07868

PROBABILISTIC SELECTION OF PROJECT DESIGN FLOODS,

Tennessee Valley Authority, Knoxville.

Bevan W. Brown, Jr.

Paper, American Society of Civil Engineers, National Water Resources Engineering Meeting, Memphis, Tenn, Jan 1970. 26 p, 6 fig, 4 tab.

Descriptors: *Probability, *Design flood, *Decision making, Spillway design flood, Design criteria, Dams, Flood forecasting, Maximum probable flood, Spillways, Hydrology, Floods, Flood damage, Risks, Statistical methods, Statistical models, *Mathematical models, Costs, *Numerical analysis, Equations, Economic justification, Design storm.

Identifiers: Spillway capacity, Design assumptions, Flood probability, Flood hydrology, Flood estimate, Selection.

Using a damsite on the lower Hiwassee River in the Tennessee River Valley as an example, the application of probabilistic techniques and decision theory in selection of project design floods is illustrated. Selection of the design flood for a structure can be divided into 2 steps: (1) forecasting probability of occurrence and magnitude of potential floods by

applying probability theory, hydrometeorology and hydrology; and (2) selecting a particular optimum design flood within the potential range by applying statistical decision theory. Current practice in selecting design floods does not utilize full statistical decision theory and is essentially arbitrary. Bayesian statistical decision theory provides a mathematical model for making engineering decisions in the face of uncertainty. The model can be used to find the optimum decision and to evaluate the price or cost of reducing the degree of risk to some lower level. Information from probabilistic economic models should not be used as the sole basis for selecting design floods, but such models do provide the framework for improving current procedures. (USBR)

W70-07887

WATER AND EFFLUENTS,

Society of Dyers and Colourists, London (England).

For primary bibliographic entry see Field 05D.

W70-07959

ECONOMIC RESPONSIBILITY FOR THE BY-PRODUCTS OF PRODUCTION,

Resources for the Future, Inc., Washington, D.C.

Allen V. Kneese.

Annals of the American Academy of Political and Social Science, Vol. 389, May 1970, p 56-62. 1 fig, 1 table, 3 ref.

Descriptors: *Economics, *Resource allocation, *Resources, Resource development, Institutions.

Identifiers: Environmental quality, System of incentives, Common property resources, Economic system.

The central concepts governing resources-allocation in the United States have historically been private property, freedom of exchange and competition. The social engine built on these concepts has produced rapid exploitation of resources and rapidly rising per capita income in the United States. In recent years, however, resources which cannot readily be reduced to private ownership have become rapidly more important, and they are being overused and misused. The pollution of such 'common property' resources as water and the air mantle is inherent in an economic system such as ours, once a certain stage of economic development is reached. To deal successfully and efficiently with these problems will require designing new governmental institutions, and especially, altering our system of incentives in such a way that the value of common property resources is reflected in market-type decisions. (Davis-Chicago)

W70-07985

OUTDOOR RECREATION ECONOMICS,

Resources for the Future, Inc., Washington, D.C., and George Washington Univ., Washington, D.C.

John V. Krutilla, and Jack L. Knetsch.

Annals of the American Academy of Political and Social Science, Vol. 389, May 1970, p 63-70. 3 ref.

Descriptors: *Recreation, *Economics, Resource allocation, Economic efficiency, Distribution, Resource mix.

Identifiers: *Outdoor recreation.

Outdoor recreation economics is an area similar to numerous other study areas in the general field of economics. Economists working in this area are concerned with the efficiency of the allocation of resources between outdoor recreation facilities and programs, on the one hand, and goods and services, generally, on the other—and, within the area of outdoor recreation, with the efficiency of the resultant mix of facilities and programs. Concomitantly, they become involved with the question of 'distributive justice', namely, the distribution of recreational opportunities among the various segments of the population. In this paper, we distinguish roughly between resource-oriented outdoor recreation and

pulation- or market-oriented outdoor recreation. In the former, we find a predominantly middle- or per-middle-income clientele and an economic environment which favors application of the analytical, management, and policy tools of 'efficiency economics'. In the latter, we find concentrations of the impoverished among ghetto residents, and the question of equitable distribution of recreational facilities and programs becomes equally as important as the efficiency with which they are provided. (Davis-Chicago)
W70-07986

RESOURCES AND SOCIAL STRUCTURE: SOME CONDITIONS OF STABILITY AND CHANGE,

Yale Univ., New Haven, Conn.

William R. Burch.
Annals of the American Academy of Political and Social Science, Vol. 389, May 1970, p 27-34. 2 tables, 15 ref.

Descriptors: *Resources, *Social change, Resource development, Resource allocation, Natural resources, Attitudes, Social values.
Identifiers: *Social structure, Society.

Human societies exist within certain resource limits. Those limits reflect particular combinations of materials, language, and social structure and determine tendencies toward social stability or change. Such issues seem best approached metaphorically. Energy stands for the level of resource-development a particular society has reached. Permeability indicates how distribution is arranged by the social structure; and myths stand for the group's available perception and its trajectory of belief. Such metaphorical coordinates may permit prediction as to the future of a society. For example, the emergence of Western industrialism was dependent upon the surplus energy of a frontier: with the closing of that frontier, the associated social structures and mythologies now seem ill-adapted to the new environmental limits. (Davis-Chicago)
W70-07987

THINKING SOCIAL-SCIENTIFICALLY ABOUT ENVIRONMENTAL QUALITY,

Pennsylvania Univ., Philadelphia, Pa.

Samuel Z. Klausner.
Annals of the American Academy of Political and Social Science, Vol. 389, May 1970, p 1-10.

Descriptors: *Environment, *Social aspects, Technology, Management, Social Values, Social needs.
Identifiers: *Environmental quality, Environmental problems.

Technological intervention to improve the quality of the environment is an immediate need. The current environmental crisis is rooted in the character of the society which develops and uses technology. The relation of society to its physical environment is governed by the society's definitions of its resources and the rules evolved for regulating social relations with respect to the environment. Fundamental solutions to environmental problems must, therefore, include social solutions. To stem deterioration of the quality of the environment will require an examination of those rules regulating the relation between individuals and the collective. (Davis-Chicago)
W70-07988

THE TECHNOLOGICAL IMPERATIVE—SOCIAL IMPLICATIONS OF PROFESSIONAL TECHNOLOGY,

McKinsey and Co., Inc., Washington, D.C.

David B. Hertz.
Annals of the American Academy of Political and Social Science, Vol 389, May 1970. p 95-106, 35 ref.

Descriptors: *Technology, *Social aspects, *Environment, Management, Social values.

Identifiers: *Technological imperative, Environmental problems, Professional technology.

Engineers and technologists have always considered themselves to be protagonists and leaders in man's struggle against nature. Each successful engineering project has been conceived as one more victory in the campaign to master the natural environment. By virtue of their successes, feeling has grown that there were no results that could not be achieved. But should man consider nature his enemy. If so, how can he win. Each time that technology has changed nature, there have been negative effects which had not been foreseen. These negative spillovers have rapidly multiplied the total environmental problem of the planet. It has now become clear that increasing population and changes in the rate of energy consumption are pushing toward a destructive total thermodynamic balance. If this change is not to be catastrophic, man will have to find a way to achieve an energy equilibrium. The technologist and engineer must be at the forefront of this search. For some reasonable expectation of success, a new approach will have to become part of technological problem-solving. This approach must involve technological assessments and evaluations that include much broader constraints than have been imposed in the past. The technological imperative calls for the reconstruction of engineering and technological curricula to include truly effective evaluation and assessment of proposed solutions to technological problems. (Davis-Chicago)
W70-07991

THE SOCIAL AND PERSONALITY CORRELATES OF OUTDOOR RECREATION,

Virginia Univ., Charlottesville.

Abbott L. Ferriss.
Annals of the American Academy of Political and Social Science, Vol 389, May 1970. p 46-55, 4 tables, 20 ref.

Descriptors: *Recreation, *Social aspects, *Psychological effects, Social values, Attitudes, Social needs.
Identifiers: Sociocultural system.

The sociocultural system, through rewards such as status, sociability of group activities, value orientations, attitudes, and the like, evokes outdoor recreation preferences, as is revealed by actual participation rates. Physical activity associated with many forms of outdoor recreation leads to more vigorous health. Physical activity groups, such as athletes engaged in a particular sport, exhibit personality traits that are different from those of nonathletes. However, it has not been demonstrated that personality traits are altered through participating in physical exercise or sport. Persons with different socioeconomic characteristics exhibit different recreation participation rates. From 1960 to 1965, these rates have been changing. Major increases in passive recreational activities have occurred, but participation rates in activities that require large allocations of natural resources have increased very little. Active forms of recreation, chiefly characterizing youth, have increased notably, while backwoods activities have increased only slightly. (Davis-Chicago)
W70-07992

ANTICIPATIONS OF CHANGE: A SOCIO-ECONOMIC DESCRIPTION OF A KENTUCKY COUNTY BEFORE RESERVOIR CONSTRUCTION,

Kentucky Water Resources Inst., Lexington.

Charles Robert Smith.

Available from the Clearinghouse as PB-192 636, \$3.00 in paper copy, \$0.65 in microfiche. Research Report No. 28, 1970. 161 p, 7 tab, 53 ref. OWRR Project A-022-KY (8).

Descriptors: *Planning, *Attitudes, Human population, *Social impact, *Social change, Social values, Kentucky, Reservoirs, Social adjustment.

In the past the construction of large reservoirs in the United States has been evaluated largely in terms of the economic benefit they bring to the area where they are constructed and to the nation. Where human populations are involved, however, a host of social changes occur, many of which fundamentally alter the way of life of a people. The report is part of a larger study which aims at analyzing the social costs and benefits of reservoir construction. This document concentrates on the social and economic description of a rural county before reservoir construction by the United States Corps of Engineers. The major findings in this study point to the preconstruction impact that the reservoir has on people.
W70-07994

6C. COST ALLOCATION, COST SHARING, PRICING/REPAYMENT

THE FIRM'S LONG-RUN AVERAGE COST CURVE,

National Chengchi Univ., Taipei (Taiwan).

Chen Fu Chang.

Quarterly Review of Economics and Business, Vol 9, No 4, p 80-84, Winter 1969. 5 p.

Descriptors: *Costs, *Economics, Economic efficiency, Optimization, Return to scale, Profits, Costs analysis, Technology, Average costs.

Identifiers: *Long-run costs, *Short-run costs, *Least cost point, Plant size, Cost curves.

The normal case of the firm's long-run average cost (LAC) curve has been known as an 'envelope' curve which is tangent to a series of the U-shaped short-run average cost (SAC) curves and which itself takes a flatter U-shape. The author finds fault with the usually assumed shape of the SAC curves which dictates that output at less than the least-cost point of the LAC curve be best produced with a larger plant operating at less than its optimum whereas the output at more than the least-cost point of the LAC curve be best produced with a smaller plant operating at more than its optimum. The author shows that with few exceptions there seems to be no reason for the least-cost of the SAC curves to be standing off the LAC curve, and the normal case of the LAC curve should consist of a series of the least-cost points of U shaped SAC curves. The theoretical implications of this article for scale of plant in water industries should make it of interest to the water researcher. (Murphy-Rutgers)
W70-07754

USE OF TAXES, SUBSIDIES, AND REGULATIONS FOR POLLUTION ABATEMENT,

Clemson Univ., S.C. Water Resources Research Inst.

For primary bibliographic entry see Field 05G.

W70-07802

6D. WATER DEMAND

PRELIMINARY COMMUNITY AND REGIONAL WATER SUPPLY DATA IN SUPPORT OF DESALTING PLANT PROJECTIONS,

Black and Veatch, Kansas City, Mo.

For primary bibliographic entry see Field 03A.

W70-07650

WATER RESOURCES OF NEW MEXICO: OCCURRENCE, DEVELOPMENT, AND USE,

New Mexico State Engineer Office, and New Mexico Interstate Stream Commission.

Santa Fe, State Planning Office, 1967. 321 p, 46 fig, 4 pl, 63 tab, 229 ref.

Descriptors: *Water resources development, *Water supply, *Planning, *New Mexico, *Hydrology, Colorado River basin, Rio Grande,

Field 06—WATER RESOURCES PLANNING

Group 6D—Water Demand

Arid lands, Geology, Semiarid climates, River basins, River basin development, Surface waters, Groundwater, Groundwater basins, Water utilization, Water resources, Natural resources, Consumptive use.

Identifiers: Arkansas River basin, Pecos River basin, San Juan River basin.

This report on the water resources of New Mexico was prepared as a contribution to the New Mexico Resources Development Plan. An introductory summary outlines statewide water conditions. Otherwise, the data presented in the report are grouped according to the nine major surface-water drainage areas of the state. These drainages are: Arkansas River basin, Southern High Plains, Pecos River basin, Central closed basins, Rio Grande basin, Western closed basins, San Juan River basin, Lower Colorado River basin, and Southwestern closed basins. Each basin report is divided into two major sections: one part deals with geography, geology, and hydrology; the other concerns the history of settlement, development, and water use. The report is amply supplied with explanatory figures and tables. (Carr - Arizona)
W70-07786

OPTIMUM OPERATION OF DESALTING PLANTS AS A SUPPLEMENTAL SOURCE OF SAFE YIELD,

Utah Water Research Lab., Logan.

For primary bibliographic entry see Field 03A.

W70-07865

6E. Water Law and Institutions

BEMIS V BEMIS (OWNERSHIP OF LAKE BEDS).

11 A2d 218-219 (Vt 1940).

Descriptors: *Vermont, *Riparian rights, *Ownership of beds, *Boundaries (Property), Non-navigable waters, Ponds, Lakes, Land tenure, Legal aspects, Lake shores, Banks, Watercourses (Legal), Boundary disputes, Lake beds, Riparian land, Riparian waters, Judicial decisions, Relative rights.

Identifiers: *Public water.

Plaintiff sued for trespass upon a lake. Defendant had title to most of the land surrounding the lake and claimed ownership of the land under it. A small parcel of defendant's land was previously owned by a third party who gave plaintiff a quit-claim deed to the lake and the land under it. Plaintiff claimed title to the center of the lake under the rule that when conveyed land is bounded by a non-navigable stream or pond, the grantee takes to the center if his grantor owned that far. Defendant claimed that plaintiff's grantor's land ran only to the banks of the lake, and was not bounded by the lake. The court held that it is a fact question whether the grantor's land bounded on the lake. Where the description of the property conveyed runs the boundary along dry land such as a bank, shore or margin of a private pond or lake, land under water is excluded from the conveyance. In the instant case, the court found that plaintiff's grantor's land ran only to the bank of the lake. Consequently, since plaintiff's grantor had no title to the bed of the lake, plaintiff acquired none. (Leesfield-Florida)
W70-07858

LOWE V GREEN MOUNTAIN POWER CORP (DISPUTE BETWEEN ADJACENT RIPARIAN OWNERS AS TO WATER RIGHTS IN POND).

11 A2d 219-222 (Vt 1940).

Descriptors: *Vermont, *Boundary disputes, *Prescriptive rights, *Boundaries (Property), Judicial decisions, Legal aspects, Relative rights, Lakes, Ponds, Land tenure, Lake shores, Boating, Dams,

Bulkheads, Bulkhead gates, Mills, Saw mills, Fishing, Water rights, Access routes, Hydroelectric plants, Real property.

Both plaintiff and defendant, owners of adjacent lots on a pond, claimed water rights to three-fifths of a dam and bulkhead on the pond, and to a part of the pond itself. Plaintiff sought to enjoin the occupation and use of such rights by the defendant power corporation. Both claimed the pond rights by virtue of the boundaries set forth in their chains of title, and plaintiff also argued that the boundary line had been established by acquiescence. Plaintiff and her predecessors had used the disputed portion of the pond for boating and fishing, for the washing of clothes, and for the operation of a saw mill. In deciding for the defendant, the appellate court held that the property conveyance upon which plaintiff relied was insufficient to establish her claim to the water rights. Moreover, the facts upon which plaintiff relied to show acquiescence were not so compelling as to require a reversal of the decision by the chancellor in the lower court. (Marsee-Florida)
W70-07862

WALDEN V PINES LAKE LAND (RIGHT OF USE BY CREATORS OF ARTIFICIAL LAKE).

126 N J Esq 249, 8 A2d 581-584 (1939).

Descriptors: *New Jersey, *Easements, *Usufructuary right, *Artificial watercourses, Lake beds, Ownership of beds, Land tenure, Contracts, Claims (Contracts), Benefits, Costs, Judicial decisions, Watercourses (Legal), Buoys, Roads, Boating, Remedies, Legal aspects, Overflow, Dams, Fishing, Water utilization, Damages, Streams.

Plaintiff and defendant owned adjoining tracts of land across which flowed a brook. Pursuant to a contract between them, plaintiff and defendant dammed the brook and created a lake upon both tracts. Defendant then proceeded to establish a dividing line of buoys across the lake, prohibiting the use of the lake as an entity. Plaintiff brought action to reform the contract, to restrain interference with his rights of use in the lake, to restrain maintenance of the buoys, and to recover damages. The court held that plaintiff, without the showing of an easement, had no right to use those portions of the lake above defendant's land. However, pursuant to the terms of their contract, each party had obtained such an easement to use the waters above the other's land. Defendants were estopped to deny plaintiff use of the entire lake. A landowner who permits flowage over part of his land to form a lake, and who pays a portion of the costs for such, obtains an easement or license to use the entire lake. (Marsee-Florida)
W70-07910

SIMELCER V RIPPETOE (PREScriptive RIGHT TO FLOOD LAND).

147 SW2d 109-115 (Tenn Ct App 1940).

Descriptors: *Tennessee, *Easements, *Prescriptive rights, *Dams, Legal aspects, Boundaries (Property), Proprietary power, Relative rights, Flooding, Repulsion (Legal aspects), Riparian land, Riparian rights, Usufructuary right, Watercourses (Legal), Concrete dams, Mill dams, Backwater, Damsites, Overflow, Floodwater, Water injury. Identifiers: *Injunction (Prohibitory).

Defendant purchased a dam and adjoining land. The dam had existed in one form or another for over 100 years, during which time the stream that impounded had continuously flooded plaintiffs' lowlands at high tides. Six years prior to defendant's acquisition of the dam, a presumably criminal dynamite explosion partially destroyed it. The release of impounded waters caused by such partial destruction eliminated the flooding of plaintiffs' land. Defendant's predecessor in title had been financially unable to repair the dam after the explosion; consequently, it had remained out of use until defendant acquired title. Plaintiffs sued to enjoin defendant's repair of the dam, contending that

previous owners had not legally owned the dam and, in any event, defendant's immediate predecessor in title had abandoned it in that it had been out of use for 6 years. The court held that the open access continued existence and maintenance of the dam for more than the prescriptive period of 20 years created a prescriptive right in the dam owner to cause flooding of plaintiffs' lands. Such right attached to the dam in serviceable condition, not merely to the damaged remains. Moreover, the financial inability of defendant's vendor to repair the dam indicated no intent to abandon it. (Clark-Florida)
W70-07867

MCDONALD V SARGENT (DESTRUCTION OF PREScriptive EASEMENT BY NONUSER).

13 NW2d 843-844 (Mich 1944).

Descriptors: *Michigan, *Easements, *Prescriptive rights, *Flood damage, Land tenure, Legal aspects, Dams, Land use, Overflow, Grants, Flooding, Streams, Judicial decisions, Pastures, Competing uses, Wetlands, Relative rights. Identifiers: *Injunction (Prohibitory).

A creek crossed plaintiffs' farm and ran below defendant's land where a dam, owned by defendants, was located. Between 1901 and 1905 the dam was washed away, and it was not rebuilt until 1930. Plaintiffs claimed that the rebuilt dam retarded the flowage of water and caused saturation of their low land, and sought to enjoin such floodage. Defendants answered that the rebuilt dam caused no greater floodage than the original dam and that by old grants and prescriptive rights plaintiffs could not recover. Plaintiffs denied the claimed grants and averred that the prescriptive rights were lost by defendants' nonuse for 25 years after the old dam was destroyed and before the new dam was erected. The court, in granting plaintiffs' injunction, held that nonuse of the dam by defendants for a period of 25 years resulted in a loss of the original easement. The court drew a distinction between easements acquired by grant, which could not be extinguished by nonuse, and easements acquired by prescription. A prescriptive easement is an unopposed continuous trespass for 15 years which can be lost by nonuse for a period equal to that required for its creation. (Leesfield-Florida)
W70-07910

WEATHER MODIFICATION IN POPULATED AREAS,

EG and G, Inc., Bedford, Mass.

For primary bibliographic entry see Field 03B.
W70-07984

GREAT LAKES INSTITUTIONS, A SURVEY OF INSTITUTIONS CONCERNED WITH THE WATER AND RELATED RESOURCES IN THE GREAT LAKES BASIN.

Committee on Multiple Use of the Coastal Zone, Washington, D.C.

Great Lakes Basin Commission, June 1969. 58 p, 3 append.

Descriptors: *Great Lakes, *Great Lakes Region, *Institutions, Federal government, Communication, Planning, Methodology, Coordination, Institutional constraints, Organizations, Governments, Administration.

The purpose of this document is to prepare a contemporary survey of institutions having responsibility for or interest in the Great Lakes which can be used as a tool by these institutions to aid in reducing confusion and improving communication and coordination. This institutional confusion is due to the dramatic increase in recent years of institutions concerned with the Great Lakes. Missions sometimes are uncoordinated and overlapping and cohesiveness and unity of purpose among these institutions require strengthening.

esumes of the various institutions concerned with the Great Lakes are presented in five major groupings: international (United States and Canada) institutions, Canadian institutions, federal (United States) institutions, states and universities, and private institutions. (Davis-Chicago)
W70-07989

AUTHORITY AND RESPONSIBILITY FOR ENVIRONMENTAL ADMINISTRATION, Indiana Univ., Bloomington.

Lynton K. Caldwell.

Annals of the American Academy of Political and Social Science, Vol 389, May 1970, p 107-115.

Descriptors: *Administration, *Environment, Institutions, Political aspects, Management, Legal aspects, Attitudes, Social values, Institutional constraints.

Identifiers: *Environmental administration, Policy, Man-environment relationships, Politico-ethical ideology, Public authority, Public responsibility.

Authority and responsibility for ecologically sound policies for man-environment relationships are confused by the lag between the changing circumstances of man-on-earth and his assumptions, behavior patterns, and institutions. In the United States, many attitudes which were hitherto feasible have now become harmful. Sanctification of political forms and unrealistic appraisals of the tendencies of technological society severely handicap present efforts to cope with environmental problems. If society is to deal effectively with these problems, political and administrative leadership will be required to help the people to understand the necessity for certain changes in their expectations, laws, and public institutions. A new, ecologically valid politico-ethical ideology is needed to legitimize the tasks of public authority and responsibility that an effective effort to cope with man's environmental problems would require. A dual crisis of attitudinal and institutional inadequacy must be surmounted if the resulting crisis of the environment is to be overcome. (Davis-Chicago)
W70-07990

THE ENVIRONMENTAL DISPOSITIONS OF ENVIRONMENTAL DECISION-MAKERS,

California Univ., Berkeley.

For primary bibliographic entry see Field 06G.
W70-07993

MORRIS V TOWNSEND (SUIT TO ACQUIRE USE OF ARTIFICIAL LAKE BY NON-RIPARIAN OWNER).

172 SE2d 819-824 (SC 1970).

Descriptors: *South Carolina, *Easements, *Lakes, *Artificial watercourses, Developed waters, Dams, Watercourses (Legal), Land tenure, Relative rights, Prescriptive rights, Water rights, Riparian rights, Judicial decisions, Legal aspects, Flooding, Surface waters, Recreation, Impoundments, Discharge (Water), Impounded waters, Drainage systems, Riparian land, Remedies, Real property.

Defendant constructed a dam on his property and created an artificial lake. Plaintiffs' predecessors in title granted an easement to defendant to flood a portion of their land in creating the lake, reserving only a right to fill in that portion if they so desired. Defendant subsequently prohibited use of the lake by plaintiffs or by residents of plaintiffs' trailer park located on land adjacent to the lake. In this action plaintiffs sought authorization for use of the lake. The court, in holding for defendant, ruled that a nonriparian owner seeking use of a lake must base his claim on a right acquired by prescription or grant. The easement created only a dominant and a servient estate and granted no right to use the lake. The sole, express reservation of the right to fill the inundated portion tended to negate the existence of other reserved or implied rights in plaintiffs. The

court did grant a request by defendants for an injunction to prohibit plaintiffs from collecting surface water in an artificial drainage system and casting them in concentrated from upon the property or the lake of defendant. (Hubener-Florida)
W70-08005

SLAYTON GUN CLUB V TOWN OF SHETEK (LAKES AND STREAMS INCLUDED IN TERM LAND).

176 NW 2d 544-548 (Minn 1970).

Descriptors: *Minnesota, *Ownership of beds, *Access routes, *Land classification, Lake beds, Land tenure, Beds under water, Local governments, Legislation, Islands, Arable land, Non-navigable waters, Real property, Right-of-way, Administrative agencies, State governments, Adjudication procedure, Judicial decisions.

Plaintiff owned 45 acres of property which was inaccessible except over lands owned by others. Pursuant to a state statute, plaintiff applied to the town board to establish a cartway between his land and a public road. The town board denied plaintiff's petition stating he did not own at least 5 acres of land as required by the statute. The court found that while plaintiff did own an area of 45 acres, less than 5 acres were above water. The court held for plaintiff, however, stating that the word 'land' in the statute included submerged land. The court stated that the word 'land', if unmodified by a restrictive word such as 'tillable', would include soil, lakes and streams. (Hubener-Florida)
W70-08006

CASTAWAYS MOTEL V SCHUYLER (STATE'S CONDITIONAL GRANT OF A RIVERBED).

25 NY2d 692, 306 NYS2d 692 (1969).

Descriptors: *New York, *Ownership of beds, *Public lands, *Administrative agencies, River beds, State governments, Navigable rivers, Flooding, Flood damage, Landfills, Navigable waters, Water rights, Water law, Management, State jurisdiction, Remedies, Legal aspects, Judicial decisions, Rivers, Land, Land tenure, Regulation, Damages, Real property.

Identifiers: *Grants (Land).

Plaintiff private landowner received from defendant Commissioner of General Services a grant of state lands beneath the Niagara River. The grant was conditional in that it contained a covenant to forego future damages. Prior to plaintiff's knowledge of the conditional nature of the grant, he expended a considerable sum in filling the land. Thereafter, plaintiff sought delivery of the lands without the condition attached to the grant. Defendant contended such condition was necessary in order to protect the state as intrusion of landfills in rivers would increase the possibility of flooding and damage in the course of public power development. The court held defendant, in having authorized a grant of state lands, could impose only reasonable conditions upon the recipient landowner, including a covenant to forego future damages. (Finman-Florida)
W70-08007

CZARNIK V SAMPSON ENTERPRISES, INC (LEASING OF PROPERTY ACQUIRED BY EMINENT DOMAIN).

175 NW2d 487-491 (Wis 1970).

Descriptors: *Wisconsin, *Condemnation, *Drainage systems, *Leases, Sewage districts, Local government, Easements, Right-of-way, Legal aspects, Land tenure, Drainage programs, Judicial decisions, Ditches, Water management (Applied), Eminent domain, Administration, Land use.

Defendant corporation acquired a lease to a certain piece of property from a county sewage district. The land originally had been condemned by the

federal government in 1944 for a perpetual easement and right-of-way for a drainage ditch, but these rights were acquired by the sewage district. Plaintiffs, whose predecessors in title owned the land in 1944, sought to enjoin use of the land by defendant, arguing that the lease increased the burden of the easement on their land. The court stated that an easement should be construed to leave the owner with the greatest possible estate since easement rights are acquired by compulsion. The estate acquired should be no greater than what is reasonably necessary to carry out the purpose of the condemnation proceeding. In holding for defendant and denying the injunction, the court ruled that the terms of the lease were consistent with the interest acquired by condemnation in 1944, and the granting of the lease did not constitute an abandonment of the rights and interests of the district in the property. (Hubener-Florida)
W70-08008

ARKANSAS LAND AND CATTLE CO V ANDERSON-TULLY CO (BOUNDARY DISPUTE CAUSED BY ACCRETION).

452 SW2d 632-641 (Ark 1970).

Descriptors: *Arkansas, *Accretion (Legal aspects), *Avulsion, *Boundary disputes, Land tenure, Boundaries (Property), Bank erosion, Water law, Mississippi River, Islands, Navigable rivers, Real property, Channel erosion, Jurisdiction, Geomorphology, Sedimentation, Sand bars, Currents (Water), Thalweg.

Plaintiff Arkansas landowner brought suit to quiet title to land located in the Mississippi River between the states of Arkansas and Mississippi. Plaintiff claimed the land was separated from the Arkansas mainland by avulsion and consequently title to the land remained in it. Defendant Mississippi landowner claimed the tract as an accretion to its lands in Mississippi. The lower court decided that the tract had been formed by erosion and accretion to defendant's land and dismissed the suit for lack of jurisdiction. The Arkansas supreme court adopted the factual findings that the area in question had been within the boundaries of sections of land owned by plaintiff according to a federal survey of 1825 and that the land in dispute was not formed until 1862-1874. The supreme court also acknowledged that the sailing channel of the river at the time of the suit ran between the tract in question and the Arkansas shore. The supreme court reversed, however, and held that the presumption that land is formed in a river by accretion rather than avulsion operates only where there is no countervailing evidence. The burden was on defendant to prove that the land in question was formed by accretion. Since defendant had failed to meet the burden of proof of accretion, the Arkansas court retained jurisdiction over the land. (Hubener-Florida)
W70-08009

UNITED STATES V SEVERSON (OWNERSHIP OF ISLANDS IN NAVIGABLE WATERS).

309 F Supp 915-917 (W D Wisc 1970).

Descriptors: *Wisconsin, *Boundaries (Property), *Islands, *Boundary disputes, Deposition (Sediments), Beds under water, Federal jurisdiction, Patents, River flow, Channel morphology, Shores, Navigable waters, Ownership of beds, Judicial decisions, Legal aspects, Accretion (Legal aspects).

The United States brought action to clear title to islands located between shorelands owned by defendants and the thread of the Mississippi River. Defendants contended that ownership of the shorelands and the operation of Wisconsin law gave them title to all lands here involved. The court held that all islands in existence in navigable waters at the time a state is admitted to the Union remain under federal ownership until specifically conveyed away. These lands were not so conveyed, and Wisconsin, therefore, had no title to convey to defendants by operation of law or otherwise. (Price-Florida)

Field 06—WATER RESOURCES PLANNING

Group 6E—Water Law and Institutions

W70-08011

UNITED STATES V RAY (FEDERAL JURISDICTION OVER AND RIGHT TO SUBMERGED CORAL REEFS).
423 F2d 16-23 (5th Cir 1970).

Descriptors: *Federal jurisdiction, *Continental shelf, *Reefs, *Beds, Coastal structures, Florida, Caissons, Coasts, Coral, Construction, Federal government, Remedies, Legal aspects, Water rights, Exploitation, Exploration, Natural resources, Public benefits, Judicial decisions, International law, Legislation, Oceans, Regulation.
Identifiers: *Injunction (Permanent), *Outer Continental Shelf Lands Act.

Defendants were rival private claimants who desired to build an island nation upon two submerged coral reefs located four and one-half miles from the coastline of Southeastern Florida. The reefs were part of a seabed of the outer continental shelf. Defendants had actually begun construction of caissons on the reefs at the time the United States, as plaintiff, brought proceedings to permanently enjoin their activities. The Court of Appeals based their granting of the injunction upon several grounds. First, defendants' activities were unlawful without the issuance of a permit from the Secretary of the Army under authority of the Outer Continental Shelf Lands Act. Secondly, plaintiff had the sovereign and exclusive right to the jurisdiction and control of these reefs for purposes of exploitation and exploration. Specifically, these reefs were within the area designated as the continental shelf by both the Outer Continental Shelf Lands Act and the Geneva Convention on the Continental Shelf. The Geneva Convention confirmed the exclusiveness of plaintiff's rights, particularly with reference to the natural resources of the continental shelf. Finally, plaintiff had a vital interest in preserving these reefs for public use and enjoyment. (Finman-Florida)

W70-08012

CHOCTAW NATION V OKLAHOMA (OWNERSHIP OF RIVER BEDS).

90 S Ct 1328-1346 (1970).

Descriptors: *United States, *Oklahoma, *River beds, *Ownership of beds, Submerged lands, Riparian rights, Federal government, Navigable rivers, Relative rights, Remedies, Legal aspects, Judicial decisions, Treaties, Water law, Leases, Patents, Royalties, Indian reservations, Federal reservations, State governments, Federal jurisdiction.

Plaintiff Indian nations brought action against defendant state to recover royalties which stemmed from mineral leases to land underlying navigable portions of the Arkansas River which ran through their reservations. Defendant claimed title to the land in question had passed to it through the granting of statehood, while plaintiffs alleged title had previously passed to them through treaties and patents. The major question involved whether the vast tracts of land granted the Indians included the beds of the navigable portions of the river which ran through the tracts. If this were to be answered in the negative, then the title would have been reserved in the United States and would have passed to Oklahoma at statehood. The United States Supreme Court reasoned that since the beds were not specifically excluded in the grants to the Indians and since questions regarding treaties with Indian nations are to be resolved in favor of the Indians, the title to the beds had passed in fee simple to plaintiffs. (Barker-Florida)

W70-08014

HARDIN V JACKSON YACHT CLUB, INC (LIABILITY FOR BOAT COLLISION WITH UNLITHTED CONCRETE WALL).
232 So 2d 721-729 (Miss 1970).

Descriptors: *Mississippi, *Accidents, *Reservoirs, *Retaining walls, Riprap, Barriers, Concrete construction, Boats, Concrete structures, Dams, Bank protection, Bank stabilization, Erosion control, Shore protection, Navigation, Warning systems, Lakes, Safety, Safety factors, Remedies, Hazards, Legal aspects, Judicial decisions.
Identifiers: *Negligence.

Plaintiff brought action against the owner of a motorboat and a yacht club to recover for the wrongful death of an occupant of the motorboat during a boating excursion upon a reservoir. The plaintiff alleged that the defendant boatowner had been negligent in operating the boat and that the defendant yacht club had been negligent in constructing the unlighted concrete retaining wall which extended out into the lake and which the boat struck at night. The lower court found the boat operator negligent but exonerated the yacht club of negligence. Plaintiff appealed contending he was entitled to a directed verdict against the yacht club. The appellate court held that the lower court had established three determinative questions: (1) whether the club was negligent in constructing the unlighted wall; (2) whether such negligence, if found, was a proximate cause of the accident; and (3) whether the boat struck the wall or a rocky section of the shoreline known as a riprap. The court held these were questions for the jury and affirmed the verdict for defendant. (Hubener-Florida)

W70-08015

PADDOCK V TOWN OF DURHAM (DAMAGES FROM TEMPORARY EASEMENT FOR SEWER CONSTRUCTION).

261 A2d 438-442 (N H 1970).

Descriptors: *New Hampshire, *Easements, *Eminent domain, *Sewers, Structures, Cities, Manholes, Sewage disposal, Damages, Costs, Condemnation, Legal aspects, Leaching, Artesian wells, Septic tanks, Domestic wastes, Judicial decisions, Riparian land, Remedies.
Identifiers: Temporary easements.

Plaintiff riparian landowner brought suit for damages to his property incurred when defendant municipality constructed a sewer line on it. Both a temporary easement for the purpose of construction and a permanent easement for continued operation had been taken by means of defendant's power of eminent domain. Plaintiff alleged that the easement prevented the construction of a boathouse on the shore of his property. Following a judgment for plaintiff, defendant appealed on grounds of improper methods of assessments of damages through the use of illegal evidence and instructions. The Supreme Court of New Hampshire held that the measure of damages for a temporary easement differs from standards applied in a permanent taking. The court stated that the measure was that of the value of the use deprived of during the temporary easement and the cost necessary to restore the property to its original value. The judgment in favor of the plaintiff was affirmed. (Hubener-Florida)

W70-08016

PARR V CITY OF ERLANGER (ASSESSMENTS FOR MUNICIPAL IMPROVEMENT BENEFITS).

438 SW2d 785-788 (Ky 1969).

Descriptors: *Kentucky, *Tangible benefits, *Cities, *Assessments, Judicial decisions, Water supply, Construction, Rates, Legal aspects, Sewers, Pipes, Taxes, Value, Evaluation, Eminent domain, Condemnation, Roads, Right-of-way, Plumbing, Water costs, Water rates, Project planning, Public health, Water transfer, Direct benefits.

Plaintiff municipality sought to collect assessments against defendant's property for street, water and sewer improvements. Defendant resisted payment alleging that the municipality knew the property

sought to be assessed was included in a planned right-of-way for an interstate highway and thus was in no way benefited by the improvements. The court held that actual benefit to the property by the improvements was inconsequential to defendant because upon sale of the condemned land, the amount received in payment was the value of the land as appreciated by the water, street and sewer improvements. The property was benefited in this manner and thus subject to assessment based on the amount of front-footage improved property. The court held further that each foot of property benefited must be proportionately assessed, not solely that portion of the property to which the improvements extended. (Barnett-Florida)

W70-08017

MARIBU V NOHOWEC (MUNICIPALITIES ADHERENCE TO STATE WATER SUPPLY STATUTES).

161 Misc 944, 293 NYS 457-464 (Sp Ct 1937).

Descriptors: *Contract administration, *New York, *Water supply, *Municipal water, Water consumption, Water works, Water control, Utilities, Bids, Contracts, Costs, Local governments, State governments, Legislation, State jurisdiction, Legal aspects, Administrative agencies, Judicial decisions, Cities.

Defendants, the mayor and trustees of a village, authorized a contract for the construction of a well and pumping equipment for the village. Plaintiff taxpayer brought this action to have the contract award declared null and void. Plaintiff contended that defendant had acted in violation of state law by failing to publicly solicit bids for the contract. In holding for plaintiff the court stated that a municipality has full power to establish or extend a waterworks system. However, the question of water supply is one of state-wide concern over which the legislature has full control. As representatives of a political subdivision of the state, defendants were required to adhere to a state statute requiring public solicitation of bids. Although the court found no fraud, bad faith or waste of the taxpayers' money, it did find a violation of the law and declared the contract null and void. (Hubener-Florida)

W70-08028

SHARP V LEARNED (CHANGE OF RIVER CHANNEL BY ACCRETION OR AVULSION).
14 So 2d 218-222 (Miss 1943).

Descriptors: *Mississippi, *Accretion (Legal aspects), *Avulsion, *Boundary disputes, Judicial decisions, Mississippi River, Rivers, River flow, Alluvium, Boundaries (Property), Meanders, Bank erosion, Erosion, Sediments, Stream erosion, Channels, Real property, State governments, Louisiana, Legal aspects, Relative rights.

Because of the continuous change of the main channel of the Mississippi River, a dispute arose over whether certain lands lay within Mississippi or Louisiana. The court held that a transfer of territory by erosion on one side of a boundary river and accretion on the other becomes a part of the state to which it is added, whereas territory transferred by avulsion continues to be a part of the original state. Accretion or alluvion was defined as that added imperceptibly and gradually, and avulsion as a change measurably visible at the time of its progress. The distinguishing test was found to be with relation to the alluvion formed by accretion which normally runs parallel to the shore. Any remarkable departure from that rule within a short period of time was held to be an inference that there had been an avulsion. Under those rules the land in question was found to be formed as the result of avulsion and not by gradual erosion and accretion. (Doublerley-Florida)

W70-08029

Water Law and Institutions—Group 6E

**AVANAUGH V TEXAS DISTRIBUTING CO
ARTIFICIAL COLLECTION AND DISCHARGE
OF WATER; LIABILITY FOR ICE FORMA-
TION.**
5 NE2d 142-148 (Ohio Ct App 1942).

Descriptors: *Ohio, *Ice, *Diversion structures, Alteration of flow, Flow around objects, Water dredging, Reasonable use, Surface waters, Surface runoff, Drainage waters, Oil industry, Discharge (Water), Water release, Runoff, Judicial decisions, Water law, Impoundments, Impounded waters, Walls, Excavation, Surface drainage, Concrete structures.
Identifiers: *Negligence.

Defendants maintained a gas station located on a steeply sloping hill. To construct the station, the site had to be filled and graded, and retaining walls were constructed to divert water off the premises. Plaintiff was injured when he slipped and fell on ice as he walked on the sidewalk along the boundary of defendants' property at a point where the retaining wall caused water to flow into the street. Plaintiff contended that in changing the grade of the lot and constructing the retaining walls, the defendants diverted the natural course of surface water and created an unusually dangerous condition in freezing weather. In holding for defendants, the court stated that a property owner can only be held liable for a dangerous condition if he has caused the artificial accumulation of surface water and has discharged it upon the public way in considerably greater amount than would have been discharged from natural causes. The court held that the evidence did not disclose any attempt to artificially accumulate surface water or divert it from a normal path. The dissenting opinion advocated liability of the jury could find that water had merely been artificially discharged from the premises. (Hubener-Florida)
W70-08031

MIX V TICE (OWNERSHIP OF BED OF LAKE).

164 Misc 261, 298 NYS 441-455 (Sp Ct 1937).

Descriptors: *New York, *Ownership of beds, *Boundary disputes, *Lake beds, Boundaries (Property), Legal aspects, Water law, Water rights, Ponds, Shores, Riparian rights, Relative rights, Judicial decisions, Land tenure, beds under water, Submerged lands, Lakes.

Plaintiff and defendants owned riparian lands around a non-navigable lake. Their titles derived from letters patent from the state land office. Plaintiff brought this action to compel removal of certain docks and piers and to enjoin defendants from making any further use of the pond on the ground that plaintiff was owner of the entire lake. Plaintiff contended that the letters patent to defendants' predecessor in title did not convey any right or title to the use of the lake. The court acknowledged that defendants had acquired no rights or title by prescriptive or adverse use but stated in holding for defendants that the law presumes that riparian owners of lands adjoining fresh-water non-navigable streams and lakes take title to the thread of the stream or the center of the body of water unless it clearly appears that the adjacent waters are excluded from the conveyance. Where the grant is framed so as to touch the water, the bed of the stream or lake is presumed to be included. Thus the words 'by the lake' or 'along the lake' contained in defendants' letters patent conveyed title to the center of the lake bed. (Hubener-Florida)
W70-08033

**CAPLES V TALIAFERRO (EXCLUDING
RIPARIAN RIGHTS IN MORTGAGE).**
197 So 861-872 (Fla 1940).

Descriptors: *Florida, *Riparian land, *Beds under water, *Boundary disputes, Judicial decisions, Statutes, Real property, Banks, Riparian rights, Navigable waters, Ownership of beds, Riparian

waters, High water mark, Beds, State governments, Shores, Seashores, Relative rights, Wetlands, Shallow water, Bays, Gulfs, Boundaries (Property), Legal aspects.

Defendant mortgagee purchased two parcels of land, one to uplands down to the high water mark of a bay and the other to the submerged lands adjoining the uplands. The uplands were mortgaged, and the description in the instrument referred to a plat which showed a narrow walkway paralleling the water's edge. Plaintiff mortgagee argued that this strip was included in the mortgage description, giving him riparian rights to the submerged land and overlying water. The court held that the conveyance of the submerged property by the Internal Improvement Fund to defendant was proper, and that the security for the mortgage did not include the walkway and the adjoining submerged lands. The court further held that defendant had validly separated the uplands and the riparian property. The dissent felt that the intent to separate the two parcels was not made sufficiently clear in the instrument, and that the riparian land was not reserved to defendant. A conveyance of land abutting a walkway was thought to convey rights to water bordering the walkway on the other side. The dissent further found that the submerged lands were not the character of those authorized for sale by the fund. (Doublerley-Florida)
W70-08035

**CITY OF BIRMINGHAM V LAKE (FISHING
RIGHTS IN WATER WORKS RESERVOIR).**
10 So 2d 24-28 (Ala 1942).

Descriptors: *Alabama, *Reservoir storage, Ownership of beds, *Fishing, Judicial decisions, Water supply, Dams, Reservoir operation, Water conservation, Water resources, Water works, Water quality, Impaired water quality, Water quality control, Abatement, Legislation, Water pollution control, Domestic water, Industrial water, Cities, Beds, Lake beds, Beds under water, Public rights, Non-navigable waters.

As a part of its water supply system, the municipality acquired title to the bed of a lake which was formed by impounding the waters of a river. To preserve the water quality the municipality enacted an ordinance forbidding entry on the water works property without the permission of city officials. Petitioner alleged fishing rights in the waters of the lake as a member of the public. The court held that fishing rights on non-riparian waters are an incident to ownership of the beds, and that the municipality when acting in its proprietary capacity was to be treated as any other property owner. The rights of the public to use city property was held to be confined to the uses for which it was held. The city had an interest in preserving the quality of its water supply, and the police jurisdiction of the city extended to the lake owned by the city outside its corporate limits. (Doublerley-Florida)
W70-08036

**GREAT HILL LAKE, INC V CASWELL
(PREScriptive RIGHTS OF LANDOWNERS
IN ARTIFICIAL LAKES).**
126 Conn 364, 11 A2d 396-398 (1940).

Descriptors: *Connecticut, *Developed waters, *Prescriptive rights, *Easements, Dams, Fishing, Boating, Swimming, Land tenure, Public rights, Relative rights, Water rights, Lakes, Recreation, Impoundments, Watercourses (Legal), Lake beds, Beds under water, Ownership of beds, Judicial decision, Legal aspects.

Plaintiff owned a dam which had created an artificial lake. Defendants owned land bordering on the lake and under the waters of the lake. Plaintiff brought action for a determination of the respective rights of plaintiff and defendants in the lake. Defendants argued they had acquired prescriptive rights to fishing, boating, bathing, watering of stock, cutting of ice and taking of water for

domestic uses. The lower court held for defendants but the appellate court reversed, stating that where such individual uses are in common with uses made by the public, the individual must perform some act to the knowledge of the servient owner clearly indicating his individual claim in order to establish a prescriptive right. However, plaintiff's right to flowage over defendants' lands was only an easement and, except as to the portion of land which plaintiff owned, he had no right to keep defendants from using the lake for boating, fishing, or bathing. The claims of the defendants as to watering of stock, cutting of ice, and taking for domestic purposes were adverse uses of plaintiff's property and were rights that could be acquired by the user. (Hubener-Florida)
W70-08038

**IN RE HUTCHINSON RIVER PARKWAY EX-
TENSION (RIPARIAN RIGHTS TO ACCRE-
TION CAUSED BY ARTIFICIAL MEANS).**
14 NYS2d 692-697 (Sup Ct 1939).

Descriptors: *New York, *Condemnation, *Riparian rights, *Accretion (Legal aspects), Boundaries (Property), Boundary disputes, Community development, Highway beautification, Judicial decisions, Legal aspects, Local governments, Proprietary powers, Public benefits, Riparian lands, Riparian waters, Watercourses (Legal), Condemnation value, Eminent domain, Public rights, Highways, Real property, Currents (Water).
Identifiers: Tide gates.

The City of New York had condemned for the extension of a parkway certain lands adjacent to the Hutchinson River. Portions of the condemned land had earlier accreted to the landowners along the river when the river's course was changed by the erection of tide gates. The issue was whether the city was liable to the landowners for the condemnation of this additional soil, the accretion of which was brought about by artificial means. The court held that the fact that the labor of other persons changed the current of the river and caused the accretion could not deprive the landowners of the right to it. The owners were entitled to a condemnation award for the land created by accretion and taken by the city. (Clarke-Florida)
W70-08041

**VILLAGE OF FLEISCHMANNS V HYMAN
(RELATIVE RIGHTS OF MUNICIPALITIES
AND STATE AGENCIES TO REGULATE DAM
MAINTENANCE).**

164 Misc 175, 298 NYS 564-570 (Sp Ct 1937).

Descriptors: *New York, *Cities, *Dams, *Supervisory control (Power), Dam construction, Dam failure, Civil engineering, Structures, Municipal water, Public benefits, Local governments, State governments, Administrative agencies, State jurisdiction, Legislation, Building codes, Permits, Legal aspects, Judicial decisions, Bulkheads, Impoundments, Maintenance, Relative rights, Impounded waters.
Identifiers: *Dam maintenance.

Defendant maintained in an unsafe condition a dam within the plaintiff village. Plaintiff village sought an injunction to enforce a village ordinance relating to the construction, maintenance, and operation of dams and to bulkheads over waters within the village. The court ruled that plaintiff was required to prove both the existence of the dangerous condition and that the ordinance in question was a proper and authorized exercise of municipal power. In holding for defendant, the court held that the state conservation law vested in the state Superintendent of Public Works full and exclusive authority over structures impounding water. Since municipal corporations derive their power from statutes, they cannot of their own initiative abrogate other state statutes or adopt local laws and ordinances conflicting or inconsistent with the provisions or purposes of state legislation. In

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prescribing a lesser penalty for an offense controlled by state law, the village had usurped the function of state provisions. (Hubener-Florida)
W70-08045

IN RE HUTCHINSON RIVER PARKWAY EXTENSION (CONDEMNATION VALUE OF RIPARIAN LAND).

33 NE2d 252 (NY 1941).

Descriptors: *New York, *Eminent domain, *Parks, *Condemnation value, Rivers, Highways, Road construction, Highway beautification, Judicial decisions, Legal aspects, Administrative agencies, Cities, Damages, Easements, Scenic highways, Land use, Riparian rights, Roads, Boundaries (Property), Condemnation, Compensation, Interest, Interest rate.

The city of New York acquired title to certain real property for the Hutchinson River Parkway Extension and for a park site. The property taken consisted of 19.6 acres fronting the Hutchinson River. The property taken amounted to approximately twenty-four per cent of claimant's total property. After the taking, claimant had two parcels of land remaining, which were separated by the parkway. The trial court awarded twelve cents per square foot for the portion of the claimant's property actually taken, but made no award for damage to the remaining land on each side of the parkway. The appellate division modified the award by increasing the rate of interest payable on the award. The Court of Appeals of New York affirmed. (Barnett-Florida)
W70-08058

CONFER V PIRMAN (BOUNDARY DISPUTE AS TO POND BED).

286 NYS 192-197 (App Div 1936).

Descriptors: *New York, *Boundary disputes, *Ponds, *Ownership of beds, Boundaries (Property), Lakes, Legal aspects, Water law, Water rights, Shores, Riparian rights, Relative rights, Judicial decisions, Land tenure, Lake beds, Beds under water, Submerged lands, Real property.

Plaintiff and defendants held adjoining land from a common grantor. The grantor had conveyed land 'on the east side' of a pond to defendants' predecessors in title. The grantor subsequently conveyed the rest of the land in the quarter to plaintiffs. Plaintiffs contended that defendants had acquired no title to land under water by their deed and that plaintiffs were the owners of the entire pond. Defendants contended that the deed in question conveyed title of the pond to the center line thereof. The lower court held for defendants and the appellate court affirmed, reciting only the facts of the case. The dissent, noting that the boundary in conveyances by several of defendants' predecessors in title had been described as 'running along the water's edge,' stated that the defendants had not acquired any lands west of the east side of the pond. (Hubener-Florida)
W70-08059

LOHR V UPPER POTOMAC RIVER COMM'N (POWER OF COMMISSION TO SUE AND BE SUED DID NOT APPLY TO TORT ACTIONS FOR NEGLIGENCE).

26 A2d 547-550 (Md 1942).

Descriptors: *Maryland, *State governments, *Administrative agencies, *Public rights, Administration, Legislation, Adjudication procedure, Flood control, Water resources development, Judicial decisions, Legal aspects, Third party effects, Political aspects, State jurisdiction.

Plaintiff brought suit in tort for injuries sustained in an automobile accident allegedly caused by the negligence of defendant river commission's employees in placing rocks and debris on a public

highway. The court, in holding for defendant, stated that it was within the power of the state to establish a district for the control of state waters and to insure adequate water supplies and flood control. As a governmental agency performing a governmental function, defendant shared the state's immunity from suit. The statutory words empowering the commission to sue and be sued applied only to such suits as were necessary to carry out the purposes for which the commission was created. A tort action could not be maintained where no authorization was given to the commission or the state to provide funds to pay damages in a tort action. (Hubener-Florida)
W70-08061

COMMONWEALTH V DOUGHERTY (POLICY BEHIND LICENSING OF PLUMBERS).

For primary bibliographic entry see Field 05G.
W70-08063

TOWN OF PURCELLVILLE V POTTS (REASONABLE USE AND DIVERSION OF WATERS FROM A NATURAL STREAM).

For primary bibliographic entry see Field 04A.
W70-08064

BARCUS V BLANCHARD (OWNERSHIP OF FORMER LAKE BED).

135 NJ Eq 533, 39 A2d 499-505 (1944).

Descriptors: *New Jersey, *Ownership of beds, *Beds under water, *Boundary disputes, Lake beds, Streambeds, Riparian rights, Boundaries (Property), Islands, Lakes, Legal aspects, Judicial decisions, Dams, Spillway gates, Reservoirs, High water mark, Ponds, Real property.

A real estate company conveyed land to defendant which contained the marshy basin of a former artificial pond. The basin was traversed by a stream which had formerly been dammed to create the pond. The deed from the real estate company's grantor had expressly conveyed the land to the edge of the lake at the time of conveyance. Defendant began dredging operations in the basin to create a reservoir. Plaintiff, a descendant of the original grantor, sought an injunction to halt the dredging claiming ownership of the basin. Defendant also claimed title to the bed. In holding for plaintiff, the court acknowledged the rule that without express words of exclusion, a conveyance of lands abutting upon an artificial lake ordinarily conveys title to the medium filum of such lake. However, the words of the grant and the intentions of the parties should also be considered in determining whether title to submerged land had passed. The court, in construing the deed, found it conveyed title only to land extending to the height of the lake at the time of the original conveyance. The court found persuasive that at the same time the original grantor had conveyed adjoining land extending title by express provision to the middle of the pond. (Hubener-Florida)
W70-08066

MCGAHHEY V MCCOLLUM (USE OF A NON-NAVIGABLE WATERCOURSE).

179 SW2d 661-664 (Ark 1944).

Descriptors: *Non-navigable waters, *Arkansas, *Navigable waters, *Boundaries (Property), Reasonable use, Legal aspects, Judicial decisions, Ownership of beds, Riparian rights, Non-consumptive use, Recreation, Fishing, High water mark, Watercourses (Legal), Water level fluctuations, Lakes, Lake shores, Hunting, Waterfowl, Relative rights, Usufructuary right.

Suit was brought to enjoin defendants from interfering with plaintiffs' use and enjoyment of a certain lake for hunting, fishing and other purposes. The trial court found that the lake had never been used for commercial navigation and was non-navigable for any purpose. The court also found

that defendants, as the owners of the entire body of land surrounding the lake, were also the owners of the land underlying the lake, their opinion being based on the law of Arkansas that a riparian owner on a non-navigable stream owns the center of it. The issue on appeal was whether the lake was in fact navigable. If it was navigable, defendants owned only to the high water mark. The court stated that to be navigable, a watercourse must have a useful capacity as a public highway of transportation. The lake in question was found to be non-navigable, and consequently the trial court's holding that plaintiffs were not entitled to the uses of the lake as a matter of right was affirmed. (Barnett-Florida)
W70-08068

WINANS LAKE HILLS CORP V MOON (RIGHTS TO RECREATIONAL USE OF POND).

284 Mich 688, 280 NW 81-83 (1938).

Descriptors: *Michigan, *Farm ponds, *Prescriptive rights, Lakes, Lake shores, Recreation, Relative rights, Riparian rights, Land use, Land tenure, Water utilization, Fishing, Contracts, Judicial decisions, Legal aspects, Boundaries (Property), Com-peting uses, Boating, Usufructuary right.

Defendants owned land abutting on a private non-navigable pond. Defendants' predecessors in title had conveyed away all rights to use of the pond except for watering of stock, cutting of ice, and drawing water for domestic purposes. Plaintiff corporation, owner of the pond, sought to restrain defendants' use of the pond for boating and fishing purposes. Defendants claimed to have acquired rights, by prescription or estoppel, to use the lake for boating and fishing purposes since they had been doing so for several years. The court granted the injunction holding that the evidence did not establish adverse use by defendants. Such use of the lake as defendants made was by permission of the plaintiffs and their predecessors in title. (Hubener-Florida)
W70-08070

WEINBURGH V SAIER (NATURAL STREAMS AS PROPERTY BOUNDARIES).

6 NW2d 921-923 (Mich 1942).

Descriptors: *Michigan, *Boundaries (Property), *Streams, *Boundary disputes, Land tenure, Judicial decisions, Meanders, Rivers, Beds, Land appraisal, Remedies, Overflow, Bank erosion, Acreage, Legal aspects, Ownership of beds, Real property.

Identifiers: *Meander line, *Homesite.

Defendant land vendor owned a parcel of land bordered on two sides by a river. Plaintiff vendee purchased two residential lots from defendant which bordered this river. Each lot was supposed to contain 8 acres. After purchase, plaintiff discovered that neither of his lots consisted of 8 acres, and sued for reformation of the contract. Defendant claimed that the acreage should be computed to the meander line of the stream which would then give the plaintiff 8 acres per lot. The court held that while abutting property runs to the meander line of a stream, it is not customary when figuring lots for homesites to also include land under water. Plaintiff was correct in not computing his acreage to the meander line, and consequently the court reformed the contract as requested. (Sisson-Florida)
W70-08071

JASPER V WORCESTER SPINNING AND FINISHING CO (ACTION TO REGISTER LAND WITH APPURTENANT EASEMENT FOR ACCESS TO WATER).

318 Mass 752, 64 NE2d 89-94 (1945).

Descriptors: *Massachusetts, *Easements, *Prescriptive rights, *Land tenure, Mills, Pipes, Water supply, Conduits, Cities, Judicial decisions,

legal aspects, Streams, Boundaries (Property), Water rights, Riparian rights, Structures, Water utilization, Industrial plants, Water conveyance, right-of-way, Real property, Relative rights, easements.

Two parcels of land were owned at one time by a manufacturing concern. A waterway ran through one of the parcels, and a canal from that waterway was used to bring water to the adjacent parcel. Upon bankruptcy the parcels of land were sold to separate individuals. Petitioner wished to register title to the parcel of land he purchased from the bankruptcy trustee, including as appurtenant hereto an easement to use and enjoy a supply of water upon the premises of the respondent, purchaser of the other parcel, and to maintain a conduit for the flow of said water to his land. The court held that where a landowner installs water pipe, drain, or other physical arrangements on part of his land for the benefit of another part, the fact that severance of title of the dominant and the servient estate is effected by simultaneous instruments does not prevent the existence of an easement. Registration of the land with the easement was allowed. (Barnett-Florida)
W70-08072

CITY OF ELKHART V CHRISTIANA HYDRAULICS, INC (ACTION AGAINST CITY TO DETERMINE RIGHT TO TAP A MILLPOND AND MAINTAIN A DAM IN CREEK).
59 NE2d 353-359 (Ind 1945).

Descriptors: *Indiana, *Mill dams, *Water supply, Riparian rights, Cities, Dams, Judicial decisions, Legal aspects, Reasonable use, Prior appropriation, Boundaries (Property), Water works, Easements, Water rights, Appropriation, Relative rights, Water utilization, Hydroelectric power, Hydroelectric plants, Prescriptive rights, Land tenure, Real property, Diversion, Natural flow, Pumping plants.

Defendant city was the successor to the grantee of a deed which gave certain realty for the purpose of installing a pumping station. The deed also gave the use of water flowing in a creek which passed the realty. The deed reserved to the grantor a right to maintain a millpond situated on the realty and the right to use the water from same for the production of power. Plaintiff, successor in interest of the grantor, brought suit to enjoin the city from tapping the millpond and to prevent the excessive utilization of the creek water. Plaintiff claimed such actions diminished his supply of water. The court held for plaintiff stating that the defendant did not have the right to draw water from the pond, or to maintain a dam in the creek below the pond, in such a way as to thereby decrease the power available to the plaintiff. An upper riparian owner may not use or divert stream water in such a way as to render it unavailable for the use of a lower riparian proprietor. The court also rejected defendant's contention that it had acquired a prescriptive right to maintain the rock dam. (Barnett-Florida)
W70-08073

AKRON CANAL AND HYDRAULIC CO V FONTEINE (RIGHT TO RECREATIONAL USE OF DAMMED WATER BY RIPARIAN OWNERS).
72 Ohio App 93, 50 NE2d 897-902 (1943).

Descriptors: *Ohio, *Usufructuary right, *Riparian rights, *Dams, Lakes, Water storage, Reasonable use, Lake beds, Fishing, Boating, Non-navigable waters, Natural streams, Water utilization, Watercourses (Legal), Impoundments, Dam construction, Legal aspects, Dam sites, Judicial decisions, Relative rights.

Plaintiff was the proprietor of a dam on a non-navigable stream. The dam had created a large lake which defendant riparian owners used for fishing and boating. Plaintiff, who held title only to the damsite area, brought this action to restrain the defendants, individually and collectively, from using the lake for fishing and boating. The court

acknowledged that there was no public right to fish or boat in a natural, non-navigable lake. However, the court held for defendants stating that a proprietor of a dam on a non-navigable stream does not acquire ownership of water stored behind his dam. The water, unlike land, is not property and not the subject of ownership. The proprietor acquires a usufructuary right to the water and is entitled to make reasonable use of it. Plaintiff's right to flowage, storage and withdrawal of water from the dammed area did not also include exclusive fishing and boating privileges as incident and appurtenant to the water rights. (Hubener-Florida)
W70-08074

STANZE V MEIER (INTERFERENCE WITH THE OPERATION OF DRAINS).
44 NE2d 360-361 (Ohio Ct App 1942).

Descriptors: *Ohio, *Drains, *Subsurface drains, *Waste water disposal, Conduits, Pipes, Relative rights, Outlets, Sewers, Tile drains, Drainage effects, Drainage practices, Water policy, Riddance (Legal aspects), Water quality, Public health, Wastes, Effluents, Solutes, Judicial decisions, Legal aspects.

Without summarizing the facts of the case or substantially identifying the parties to the suit, the appellate court upheld a trial court injunction and ordered defendant not to destroy, alter or obstruct the operation of a cellar drain upon his premises. The court also sustained an injunction ordering plaintiff to refrain from using his basement drain for the disposal of wash water or for other domestic purposes, and to work out an agreement with defendant for disposal of wash water through a common drain on defendant's premises. (Hubener-Florida)
W70-08076

RESERVOIR RECREATION CORP V HODDER (PROPERTY RIGHTS IN BEDS UNDER WATER).
29 NE 2d 913-915 (Mass 1940).

Descriptors: *Massachusetts, *Reservoirs, *Riparian rights, *Beds under water, Highwater mark, Riparian waters, Recreation, Wildlife, Landfills, Structures, Riprap, Lakes, Banks, Lake beds, Recreation facilities, Swimming, Public health, Reservoir operation, Social aspects, Construction, Judicial decisions, Legal aspects, ownership of beds, Real property, Docks, Relative rights, Usufructuary right.

Plaintiff corporation was organized to encourage aquatic enjoyment to promote the study and propagation of wildlife and to provide for recreation and social enjoyment of its members. Plaintiff owned land covered by the waters of a lake to the high water mark. Defendant owned land above the high-water mark. Defendant constructed and maintained a dock, float, wall and fill which allegedly encroached on plaintiff's property. Plaintiff brought action to compel the removal of these structures. The court found the maintenance of the structures complained of constituted a continuing trespass against the plaintiff for which a mandatory injunction would issue even though the damage might be slight and the expense of removal disproportionate. (Barnett-Florida)
W70-08077

UNITED STATES LEATHER CO V CITY OF LYNN (TITLE TO AND BOUNDARIES OF SUBMERGED LAND).
199 NE 313-315 (Mass 1935).

Descriptors: *Massachusetts, *Ponds, *Boundaries (Property), *Ownership of beds, Cities, Mills, Judicial decisions, Legal aspects, Contours, Elevation, Riparian rights, Obstruction to flow, Reasonable use, Prior appropriation, Mill dams, Structures, Pipes, Flow, Grants, Legislation, Great ponds, Surface waters, Boundary disputes, Real property.

Plaintiff petitioned to register title to a mill pond under a grant which was the subject of construction by the trial court. Petitioner asserted title in fee to the pond up to a water line of an elevation of 74, Lynn city base. Defendant-city claimed title in itself subject to the right of petitioner to use the pond at that elevation. The court traced the chain of title in the pond through 300 years and found that the grant made to petitioner was of the fee of the pond including all land within its borders, subject to the right of an unobstructed flow therefrom for mills on the stream below. The court further determined that contour 74 of the pond was not an arbitrary line, but was the water line at the elevation of the dam as regulated by an overflow pipe. (Barnett-Florida)
W70-08078

HOOD V MURPHY (Public right to fish in non-navigable stream).
6 Div 862, 165 So 219-221 (Ala 1936).

Descriptors: *Alabama, *Fishing, *Non-navigable waters, *Ownership of beds, Streambeds, Boundaries (Property), Upstream, Navigable rivers, Fresh water, Federal government, Streams, Legal aspects, Judicial decisions, Remedies, Public lands, Public rights, Patents, Freshwater fish, Relative rights, Land tenure, Real property, Recreation demand.

Identifiers: *Injunction, Trespass.

A small, fresh-water stream passed through plaintiff's property. It appeared that fish were plentiful in this non-navigable stream, especially within plaintiff's boundary lines. Over plaintiff's protests, defendant entered the stream below plaintiff's property line and proceeded upstream within plaintiff's boundaries. Defendant then proceeded to fish, as he stood on the river bottom. Plaintiff sought to enjoin such fishing. Contending the state owned the river bed, defendant maintained that he had not actually trespassed upon plaintiff's property. The court, however, held that the state owned only navigable streambeds. The lands upon which non-navigable streams were located had once been public land, ceded to the United States. However, the federal government patented this land and passed title to patentees and their successors in ownership. The public had no right to fish in waters flowing over such land. Plaintiff, therefore, had exclusive fishing rights in the non-navigable stream. (Finman-Florida)
W70-08080

CITY OF SYRACUSE V GIBBS (STATE CONTROL OVER POTABLE WATER DISTRIBUTION).

258 App Div 405, 17 NYS2d 293-302 (Sup Ct 1940).

Descriptors: *New York, *Administrative decisions, *State jurisdiction, *Water supply, Community development, Equitable apportionment, Judicial decisions, Legal aspects, Legislation, Local governments, Preferences (Water rights), Public rights, Public benefits, Relative rights, State governments, Water rights, Administrative agencies, Water allocation (Policy), Water demand, Cities, Conduits.

Identifiers: *Public trust doctrine.

Defendant water commission issued an order forcing plaintiff city to allow a smaller village to tap into its water supply conduit. The village was to draw off up to 69 million gallons per year at a fixed rate payable to defendant. Plaintiff had obtained its right to use and consume the water of a particular lake by a series of state statutory grants. Plaintiff contended that these grants entitled it to operate without interference, and that defendant had no authority to issue such an order. The court held that the distribution of potable water is a right held in trust by the state for the benefit of all its inhabitants. Therefore, a state may not divest itself of control of rights held for the benefit of all the people. The commission was by statute delegated the

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power to supervise the equal distribution of potable water to the residents of the state. However, the defendant commission was not given express statutory power to exercise ownership and dominion over the conduits constructed and owned by plaintiff, nor was it given statutory power to set specific rates which plaintiff must charge for the use of the conduits by the village. The commission's order was annulled. (Clarke-Florida)
W70-08082

EASTON V STATE (DAMAGES TO RETAINED PORTION OF LAND CAUSED BY USE OF APPROPRIATED PORTION).

245 App Div 439, 283 NYS 809-812 (App Div 1935).

Descriptors: *New York, *Springs, *Eminent domain, *Condemnation value, Subsurface waters, Wells, Underground streams, Underground, Road construction, Highways, Highway effects, Judicial decisions, Legal aspects, Water pollution, Water pollution effects, Groundwater, Civil engineering, Condemnation, Right-of-way, Relative rights, Land use, Compensation.

Identifiers: State governments, Condemnation.

Plaintiff landowner was awarded a fair amount of compensation for land taken by the state in the vicinity of a railroad crossing. Plaintiff continued to live on adjacent property and reserved the right to take water from a spring located on a portion of the appropriated land. The state constructed a new highway over the appropriated land and dirt and roily substances from the gutter percolated into the subterranean watercourses which fed the spring. The spring was rendered useless to plaintiff and he sought compensation for the damages accruing to the retained land. The court, in holding for plaintiff, stated that the damages had resulted from the initial taking of his land and the construction of the highway. Where land is taken without the consent of the owner, he is entitled to recover the market value of the property and any damages to the residue by reason of the use to which the appropriated part is put. (Hubener-Florida)
W70-08084

GROBART V PASSAIC VALLEY WATER COMM'N (PRESCRIPTIVE RIGHTS TO DIVERT WATER).

135 NJ Eq 38, 37 A2d 98-99 (1944).

Descriptors: *New Jersey, *Diversion, *Prescriptive rights, *Reasonable use, Judicial decision, Legal aspects, Routing, Riparian rights, Water works, Water demand, Water supply, Consumptive use, Preferences (Water rights), Domestic water, Priorities, Rivers, Remedies.

Complainants were owners of land bordering the Passaic River. They sought to enjoin defendant from abstracting water from the river above their lands. Defendant's defense was that it had title or a prescriptive right to the water arising out of continuous user of the water for twenty years. Defendant did not dispute complainants' right to prevent abstraction in excess of the prescriptive right, but argued that the amount of the user allowed should be the average of the twenty years use and not, as plaintiff alleged, the minimum amount used in any single year. The court, in holding for plaintiff, stated that the extent of a prescriptive right to divert water from a river could not exceed the lowest average daily abstraction of any one year. (Barnett-Florida)
W70-08085

GROBART V PASSAIC VALLEY WATER COMM'N (PRESCRIPTIVE RIGHT TO DIVERT WATER--COMPUTATION OF ALLOWABLE DIVERSION AMOUNT).

34 A2d 284-285 (N J Ch 1943).

Descriptors: *New Jersey, *Diversion, *Prescriptive rights, Reasonable use, Judicial decisions, Legal aspects, Routing, Riparian rights, Water works, Water demand, Water supply, Consumptive use, Preferences (Water rights), Domestic water, Priorities, Rivers, Usufructuary right.

Complainant, who owned land bordering on the Passaic River on which factory buildings were erected, sought an injunction against defendant's allegedly unlawful and injurious diversion of water at a point above her lands. Defendant claimed a prescriptive right based on adverse user of the waters for a period of at least twenty years. Objection was raised by complainant as to the method of computation and accuracy of the measurement of the amount of waters diverted by defendant. Defendant measured average daily flow through the meters for each month, then added the total of a twelve months' flow and divided the total by twelve. The court held that this method of computation was adequate, and that defendant had established an adverse user which had ripened into a prescriptive right to divert a daily average of water equaling 22.6 million gallons. However, the proofs had shown that defendant had exceeded that figure, and consequently complainant was entitled to an injunction against a greater diversion than 22.6 million gallons. (Barnett-Florida)
W70-08086

PAMRAPAU CORP V CITY OF BAYONNE (RELATIVE RIGHTS IN SUBMERGED LAND IN FRONT OF RIPARIAN PROPERTY).

8 A2d 835-837 (N J Ch 1939).

Descriptors: *New Jersey, *Ownership of beds, *Riparian rights, *Riparian land, Beds under water, Harbors, Water law, Condemnation, State governments, Local governments, Land tenure, Navigation, Docks, Piers, Judicial decisions, Legal aspects, Relative rights, Riparian waters, Land use, Leases, Grants, Compensation.

Plaintiff was a riparian owner of lots bordering on New York Bay. In 1886 defendant city, which then owned the lots, received through a state grant rights to use the land under water in front of the lots for public purposes such as construction of docks. The right was to continue as long as defendant owned the lots. Defendant subsequently sold the lots and plaintiff eventually acquired them. After plaintiff's acquisition, defendant attempted to lease the same submerged lands to defendant construction corporation for construction of a marine terminal. Plaintiff sought: (1) to remove the cloud upon his title to the lots caused by the lease; and (2) either an injunction against the construction of the terminal or damages for the deprivation of his riparian rights. The court ruled that defendant city had acquired an estate upon limitation in the grant from the state and by its conveyance of the upland lots lost the rights granted with respect to the submerged lands. Riparian owners hold pre-emptive rights to grants or leases of submerged lands in front of their uplands unless, after six month notice of a proposed state grant, the owner fails to apply for such a grant. On failure to so apply, such an owner is still entitled to compensation, since this riparian right is a property right. Defendant was given time to acquire complainant's rights either by purchase or condemnation. (Hubener-Florida)
W70-08088

MILLER V MILLER (PROPERTY RIGHTS IN ARTIFICIAL LAKES).

7 A2d 3 (Pa 1939).

Descriptors: *Pennsylvania, *Lakes, *Recreation, *Prescriptive rights, Easements, Boats, Swimming, Fishing, Legal aspects, Judicial decisions, Riparian rights, Ownership of beds, Artificial watercourses, Usufructuary right.

The owner of bathing, fishing and boating privileges in an artificial lake conveyed one-fourth interest in such privileges to another. The interest

in the lake had been acquired by deed and prescription. The Supreme Court of Pennsylvania, in a per curiam decision, stated that these privileges given to the grantee and his assignee were the exclusive property of them and their heirs. The court found that the owner of the land under the lake had no interest in or to the granted rights. (Barnett-Florida)
W70-08089

BALTIMORE V BRACK (ACQUISITION OF EASEMENT BY CONDEMNATION).

3 A2d 471-476 (Md 1939).

Descriptors: *Maryland, *Cities, *Condemnation, *Easements, Land tenure, Public rights, Public health, Public utilities, Water works, Compensation, Regulation, Permits, Administration, Eminent domain, Local governments, Judicial decisions, Legal aspects, Right-of-way, Economic impact, Condemnation value, Economic feasibility, Prescriptive rights, Remedies.

Identifiers: *Injunction (Mandatory).

Plaintiff purchased a tract of land through which defendant city had run underground water mains. The mains had been installed with the consent of plaintiff's predecessor in title; however, no license had been executed and recorded, and the city had granted no consideration for use of the land. Plaintiff sought an injunction to require removal of the utilities. The court held that unrecorded grants of easement could not pass to succeeding owners by parole and, apart from prescriptive rights, easements could only be acquired according to statutory requirements. The city had acquired only a revocable license to use plaintiff's land and until the utilities were removed or an easement acquired by condemnation, was liable to plaintiff for reasonable compensation for use of the license. However, reviewing a municipality's duty to supply sewage and water facilities, the court found that, in view of the harm which would result to the public, a balancing of equities would not require removal of the utilities. The court granted the city time to acquire an easement by condemnation proceedings. (Hubener-Florida)
W70-08091

MILLER V MILLER (RELATIVE RIGHTS TO USE OF ARTIFICIAL LAKE).

200 A 652-653 (Pa 1938).

Descriptors: *Pennsylvania, *Ownership of beds, *Usufructuary right, *Artificial watercourses, Docks, Beds under water, Piers, Lake beds, Land tenure, Relative rights, Riparian rights, Recreation, Remedies, Fishing, Boating, Swimming, Permits, Water rights, Watercourses (Legal), DEVELOPED WATERS, Permits, Recreation facilities.

Identifiers: *Trespass.

Defendants owned the land under the waters of an artificial lake. Plaintiff, who owned land abutting on the lake, constructed a dock which protruded into the water. Defendants' agents tore down the dock and posted notices warning all people that they might boat, bathe, and fish in the lake only if licensed by defendants' lessee. Plaintiff sought an injunction to prevent interference with their enjoyment of the lake and also sought an accounting of the profits from exploitation by the defendants of fishing, boating and bathing privileges in the lake. The court held that the part of the dock which protruded into the lake was a trespass, and defendants were justified in destroying it. However, damages could be recovered for destruction of the part built on plaintiff's land. The court also recognized that plaintiff had a one-fourth interest in the boating, bathing and fishing privileges in the lake and was entitled to an accounting of the proceeds from the commercial use of such privileges by defendants. (Hubener-Florida)
W70-08092

HOBAN V BUCKLIN (PREScriptive RIGHT TO MAINTAIN STRUCTURES BUILT ALONG LAKE SHORELINE).

186 A 8-12 (NH 1936).

Descriptors: *New Hampshire, *Docks, *Prescriptive rights, *Recreation facilities, Boundaries (Property), Piers, Public rights, Recreation, Navigation, Right-of-way, Land tenure, Easements, Riparian rights, Water rights, Boating, Fishing, Lakes, Land use, Recreation demand, Legal aspects, Usufructuary right, Competing uses, Judicial decisions, Swimming, Structures.

Plaintiff owned and operated a boys' camp on land along a highway. On the opposite side of the highway were a narrow strip of land and then a lake. Plaintiff's predecessor in title had erected a small wharf extending out into the lake. Plaintiff had added a boathouse and a diving structure near the wharf. Plaintiff brought action to establish a prescriptive right to maintain these structures as against defendant who owned the strip of land between the lake and the highway. The defendant asked for removal of the structures. The court held that, in order for plaintiff to count his grantor's period of adverse use of the wharf in establishing a prescriptive right, privity of estate was necessary between the grantee (plaintiff) and the grantor. Moreover, each structure must have been erected and used adversely for the full 20 year period. The period of acquisition could not begin when there was nothing to show appropriation of a site. The court found plaintiff entitled to the use of the wharf but not the boathouse. The diving tower, although an obstruction to navigation, did not invade defendant's riparian rights. The court also held that plaintiff could not establish a public right to erect the structures without an express grant from the public. (Hubener-Florida)

W70-08094

WATSON V HOLLAND (POWER OF STATE TO GRANT DRILLING RIGHTS ON SUBMERGED SOVEREIGN LANDS).

20 So 2d 388-394 (Fla 1944).

Descriptors: *Florida, *Ownership of beds, *Leases, *Navigable waters, Public benefits, Judicial decisions, Legal aspects, Land tenure, Legislation, Motivation, Pollution, Public rights, Recreation, Relative rights, Social aspects, Social needs, State governments, Watercourses (Legal), Oil wells, Natural use, Jurisdiction, State jurisdiction, Administrative agencies, Oil industry.

Identifiers: *Trust doctrine.

The appellant Attorney General of Florida sought injunctive relief and cancellation and rescission of an oil lease granted by the Trustees of the Florida Internal Improvement Fund. The lands leased were under navigable waters, and the Attorney General contended that the lease thereof was in conflict with the trust doctrine. He also contended that there was no state constitutional or statutory authority for such lease. The court held that subject to the authority of Congress over navigable waters, and subject to vested private property interests, the state has power to legislate concerning the disposition and use of lands beneath navigable waters within the territorial limits of the state. Such legislative acts must be within the bounds set by the state constitution. It has long been the established public policy that the state may, if done in accordance with the appropriate statutes, part with portions of its land under navigable waters. Statutes did empower the Trustees to lease land under state waters to individuals for drilling purposes. The terms of the lease provided safeguards against objectionable operation of the wells and possible pollution. The decree appealed was affirmed. (Price-Florida)

W70-08108

6F. Nonstructural Alternatives**FLOOD PLAIN INFORMATION, COASTAL FLOODING OF NORFOLK, VIRGINIA.**
Corps of Engineers, Norfolk, Va.For primary bibliographic entry see Field 04A.
W70-07909**6G. Ecologic Impact of Water Development****THE ENVIRONMENTAL DISPOSITIONS OF ENVIRONMENTAL DECISION-MAKERS,**
California Univ., Berkeley.

Kenneth H. Craik.

Annals of the American Academy of Political and Social Science, Vol 389, May 1970. p 87-94, 27 ref.

Descriptors: *Decision making, *Environment, *Psychological effects, *Social aspects, Attitudes, Social values.

Identifiers: *Environmental disposition, Environmental decision maker.

A new interdisciplinary field of research has recently emerged which studies how persons comprehend the everyday physical environment, how they use it, how they shape it and how they are shaped by it. In seeking an objective understanding of the behavioral aspects of the total personal-societal-environmental system, professional environmental decision-makers, such as architects, urban planners and natural-resources managers, are strategic choices for psychological study. Within this context of environmental design and management, research is being directed toward clarifying the implicit assumptions about environmental behavior held by decision-makers, overcoming social and administrative distances from clients, and conducting systematic follow-up evaluations of the behavioral consequences of planning and design decisions. However, subtle and precise study of man-environment relations will require the development of psychological techniques providing a comprehensive and differentiated description of any person's orientation to the everyday physical environment. Methods for measuring individual differences in environmental dispositions are reviewed and their potential usefulness for advancing knowledge of the interplay between human behavior and the physical environment is illustrated. (Davis-Chicago)

W70-07993

07. RESOURCES DATA**7A. Network Design****NATIONAL SYSTEM FOR WATER DATA,**
Geological Survey, Washington, D.C. Water Resources Div.

Russell H. Langford, and George H. Davis.

ASCE Proceedings, Journal of the Hydraulics Division, Vol 96, No HY7, Paper 7392, p 1391-1401, July 1970. 11 p, 2 fig.

Descriptors: *Data collections, *Hydrologic data, *Data storage and retrieval, *Information retrieval, Data processing, Documentation, Legislation, Governments, Libraries, Publications, Federal Government.

Identifiers: Data management, National system for water data, Office of Water Data Coordination.

Bureau of the Budget Circular A-67, August, called for coordination of certain water data acquisition by Federal agencies. The Department of the Interior's Office of Water Data Coordination was given responsibility to: (1) Design and operate a National Water Data Network; (2) coordinate national net-

work and specialized water data activities and prepare an annual Federal Plan for water data acquisition; and (3) maintain a catalog of information on water data, and on Federal activities planned or conducted to acquire such data, and to organize network data. The Catalog of Information on Water Data is a file of information on water data acquisition activities and Indexes are published. A level of information approach to network design has three informational levels: Level I, base level for national and regional planning; Level II, subregional planning objectives; Level III, local operation and management objectives; the accounting element of the Level I, streamflow and stream quality was designed. An Interior Water Data System was developed and will be expanded to non-Interior Federal agencies. Field coordination initially will involve four field coordinators to review agency plans and needs for water data. (Knapp-USGS)
W70-07663

THE DESIGN OF NOZZLE NETWORKS FOR THE SIMULATION OF RAINFALL,
Imperial Coll. of Science and Technology, London (England).

M. J. Hall.

Journal of Hydraulic Research, Vol 7, No 4, p 449-483, 1969. 35 p, 12 fig, 3 tab, 6 ref.

Descriptors: *Rainfall simulators, *Hydraulic models, *Rainfall-runoff relationships, Artificial precipitation, Simulated rainfall, Instrumentation, Nozzles, Rainfall disposition, Distribution patterns. Identifiers: Nozzle networks.

A method is given for designing a network of nozzles to generate artificial rainfall. A simple design of swirl-type nozzle was devised and the effect of the internal geometry of the swirl-producing component of this nozzle on its dispersion properties is illustrated. Statistical coefficients are used as measures of the uniformity of the application pattern from a network of nozzles. A method of generating the patterns from networks with different spacings of nozzles by using the distribution of depths from one nozzle is outlined, and the details of a computer program for performing the calculations are presented. (Knapp-USGS)
W70-07674

HYDRODYNAMIC STUDIES OF TIDE GAUGES,
Liverpool Univ. (England). Dept. of Civil Engineering.

A. Roy Halliwell, and John G. Perry.

Journal of Hydraulic Research, Vol 7, No 4, p 485-517, 1969. 33 p, 12 fig, 2 tab, 11 ref.

Descriptors: *Tidal waters, *Gaging stations, *Water levels, *Instrumentation, Gages, Stream gauges, Calibrations, Water measurement, Laboratory tests.

Identifiers: Tide gages.

When tide gages of the float and well type are situated so that there is a flow past them, an error is introduced into their readings as a result of the flow. A relationship was developed for the well orifice pressure coefficient in terms of Reynolds number, Froude number and two geometric ratios. The relationship was investigated by model tests on various tidewell end-shapes and orifice configurations. The wells giving least error from this effect are found to be the shrouded cone and the standard American gage. A study was made of the magnitude of current error and several alternatives for eliminating it are suggested. (Knapp-USGS)
W70-07675

MONTANA TELEMETRY SYSTEM,
Soil Conservation Service, Bozeman, Mont.; and Montana State Univ., Bozeman. Dept. of Engineering.

Phillip E. Farnes, and John Rompel.

Field 07—RESOURCES DATA

Group 7A—Network Design

Proceedings 37th Annual Meeting of Western Snow Conference, April 15-17, 1969, Salt Lake City, Utah; printed by Colorado State University, Fort Collins, p 102-107, 1969. 6 p, 4 fig.

Descriptors: *Remote sensing, *Telemetry, *Snow surveys, *Montana, Data collections, Instrumentation, Streamflow forecasting.

Identifiers: Snow survey telemetry.

The snow survey telemetry system in use near Bozeman, Montana consists of 3 remote data sites, 2 repeaters, and a base station. Propane generators power the repeater station. Four dry cell batteries provide a 1-year power supply for the remote sites. A clock at the site initiated hourly transmission of snow pillow, total precipitation, and air temperature data. Snow pillow and precipitation data were obtained from potentiometers attached to Leupold-Stevens Type F recorders. A thermistor bridge is used as a temperature sensor. Received data are recorded automatically on Esterline-Angus strip chart recorder at the Snow Survey office in Bozeman. Pressure transducers were substituted in the hydraulic system to replace the potentiometers. Data can most advantageously be transmitted in analog form, allowing the remote site equipment to be kept as simple (hence trouble free and low cost) as possible. Punched paper tape was chosen as the most economical form of data record for computer input. All equipment is solid state. The automatic call-up sequence can be initiated by an external timer or a noon or midnight or both by the digital clock in the digital data recorder. With continuous data, need for regular snow surveys on specific dates is reduced. Field measurements can be adjusted to first-of-month or mid-month readings by comparing with telemetered data. Early season measurements can be greatly reduced as correlation between pillows and snow courses is developed. Accurate data on melt, heavy precipitation, and other unusual climatic occurrences can be noted as they occur. Accurate measurements of total precipitation can be obtained by using both snow pillows for snowfall and precipitation gages for rainfall and combining them. (See also W70-07530). (Knapp-USGS)

W70-07678

7B. Data Acquisition

APPLICATIONS OF AIRBORNE REMOTE SENSING TECHNOLOGY,

Wisconsin Univ., Madison. Dept. of Civil Engineering.

Ralph W. Kiefer, and James P. Scherz.

ASCE Proceedings, Journal of the Surveying and Mapping Division, Vol 96, No SU 1, Paper 7225, p 57-80, Apr 1970. 24 p, 19 fig, 44 ref.

Descriptors: *Remote sensing, *Aerial photography, Radar, Thermal radiation, Photogrammetry, Infrared radiation, Water pollution, Soil surveys, Terrain analysis, Monitoring, Planning.

Identifiers: Side-looking radar.

Recent developments in aerial photography, such as color film, color infrared film, and multiband photographic systems, have greatly increased the amount of useful information obtainable from aerial photographs. Remote sensing instruments that operate in different parts of the electromagnetic spectrum from the human eye and photographic sensors can detect many things beyond the scope of human and photographic sensors. Thermal imagery can detect thermal pollution entering streams. Side-looking airborne radar can map terrain day or night, almost without regard for weather conditions. Remote sensing instruments having civil engineering applications are described herein. The emphasis is on photography, thermal imagery, multispectral imagery, and side-looking airborne radar. Applications of airborne remote sensing technology to soils mapping, water pollution detection and monitoring, and urban and regional planning are illustrated. (Knapp-USGS)

W70-07649

FLOW ANALYSIS OF LARGE TRIANGULAR WEIR,

Agricultural Research Service, Chickasha, Okla.

Donn G. DeCoursey, and Bruce J. Blanchard.

ASCE Proceedings, Journal of the Hydraulics Division, Vol 96, No HY7, Paper 7405, p 1435-1454, July 1970. 20 p, 9 fig, 3 tab, 11 ref, 5 append.

Descriptors: *Weirs, *Flow measurement, *Gaging stations, *Alluvial channels, *Calibrations, Open channel flow, Streamflow, Instrumentation, Unsteady flow, Stream gages, Stage-discharge relations.

Identifiers: Large triangular weirs.

V-notch weirs have often been used to stabilize the ratings of streamflow stations in unstable alluvial channels. The theoretical development and interaction of weir flow, submergence, and unsteady flow are discussed. Two different equations are derived to describe weir flow. The equations are more accurate than conventional weir flow equations. If the weir rating is based upon both the static and velocity heads, the effect of submergence is one of a superposition of flows. The rate of change of stage does not fully define unsteady flow. (Knapp-USGS)

W70-07660

STREAMFLOW FORECASTING, A VITAL ELEMENT IN WATER MANAGEMENT,

Bureau of Reclamation, Salt Lake City, Utah.

David L. Crandall.

Proceedings 37th Annual Meeting of Western Snow Conference, April 15-17, 1969, Salt Lake City, Utah; printed by Colorado State University, Fort Collins, p 92-96, 1969. 5 p, 4 fig.

Descriptors: *Streamflow forecasting, *Colorado River, *Snow surveys, *Reservoir operation, Optimization, Multiple-purpose projects, Hydroelectric power, Irrigation, Recreation, Water management (Applied), Planning.

Within the constraints of operating the reservoirs of the Colorado River Storage Project to meet compact delivery requirements for fish and wildlife, float boaters and other recreationists, to control floods, help highway bridge builders, and aid water deliveries for communities, farms, and industries, there is still opportunity to attempt optimum use of the available water for power production. The bulk of the cost of the storage project is being paid by power production. Project water use comes in the form of electric energy over a wire. Project power income is now about \$20 million per year. With the combined effect of streamflow plus the head versus volume relationship being unique at each reservoir with a powerplant, the distribution of storage among the reservoirs is aimed at developing maximum systems energy and capacity. The streamflow forecasting method used by the Bureau of Reclamation is based on a correlation of streamflow at a particular site with the accumulated precipitation at selected gaging stations plus snow depths at specific courses within the contributing drainage basin. Above Glen Canyon Dam, the Bureau uses precipitation stations and 48 snow courses. Emphasis is placed on the application of the probability of the forecast runoff deviating from the actual runoff. Most management decisions recognize a deviation range exceeded less than one out of ten times in the past. (See also W70-07530) (Knapp-USGS)

W70-07677

GEOLOGICAL STRUCTURES OF THE RED SEA AREA INFERRED FROM SATELLITE PICTURES,

North American Rockwell Corp., Thousand Oaks, Calif. Science Center.

Momen Abel-Gawad.

In: Hot Brines and Recent Heavy Metal Deposits in the Red Sea; published by Springer-Verlag New York Inc. p 25-37, 1969. 13 p, 5 fig, 15 ref.

Descriptors: *Remote sensing, *Satellites (Artificial), *Geology, *Oceanography, Brines, Mineralo-

gy, Sea water, Water chemistry, Water temperature, Photography, Aerial photography, Faults (Geology), Fractures (Geology), Exploration, Surveys, Geophysics.

Identifiers: *Red Sea, Hot Brines.

Photographs of the Red Sea area taken during the Gemini earth-orbiting missions show the gross structural relationship between the highlands of the Arabian-Nubian shield, the sediment-filled Red Sea 'graben' system and the marginal sedimentary cover with large areas of volcanic activity. Among five major systems of faults affecting the Arabian-Nubian massif, three systems trending N, NW, and WNW appear to have a profound influence on the structure of the Red Sea. The other systems oriented NE and E are more evident in the Gulf of Aden area. The fissure systems control the coastal outlines, and major physiographic features such as depressions, drainage lines, and much of the Nile Valley. The relative positions of two pairs of shear zones intersecting the northern part of the Red Sea provide additional geological evidence consistent with the relative northward movement of Arabia some 150 km. The regional fissure system disposition may be interpreted in terms of a combination of shear and tension producing conjugate fissures and gravity faults. (See also W70-07394) (Knapp-USGS)

W70-07680

THE PERFORMANCE OF THREE TYPES OF LEAF-WETNESS RECORDERS,

Israel Meteorological Service, Bet-Dagan. Agrometeorological Div.

For primary bibliographic entry see Field 02I.

W70-07774

THE QUANTITATIVE DESCRIPTION OF SOIL MOISTURE STATES IN NATURAL HABITATS WITH SPECIAL REFERENCE TO MOIST SOILS,

University Coll. of Wales, Aberystwyth.

For primary bibliographic entry see Field 02G.

W70-07800

METHODS FOR COLLECTION AND ANALYSIS OF WATER SAMPLES,

Geological Survey, Washington, D.C.

F. H. Rainwater, and L. L. Thatcher.

For sale by Superintendent of Documents, U.S. Government Printing Office, Wash. D.C. - 20402. Price \$1.50. US Geological Survey Water-Supply Paper 1454, 1968 (Fifth printing). 301 p, 17 fig, 3 tab.

Descriptors: *Analytical techniques, *Sampling, *Water quality, *Water analysis, Data collections, Hydrologic data, Water chemistry, Laboratory tests, On-site tests, Instrumentation, Water properties.

Identifiers: Water sampling, U. S. Geological Survey.

This manual contains methods used by the U. S. Geological Survey to collect, preserve, and analyze water samples. Throughout, the emphasis is on obtaining analytical results that accurately describe the chemical composition of the water in situ. Among the topics discussed are selection of sampling sites, frequency of sampling, field equipment, preservatives and fixatives, analytical techniques of water analysis, and instruments. Seventy-seven laboratory and field procedures are given for determining 53 water properties. (Knapp-USGS)

W70-07911

DETERMINATION OF NITRATE IN WATERS WITH THE NITRATE-SELECTIVE ION ELECTRODE,

Wisconsin Univ., Madison. Dept. of Soils.

D. R. Keeney, B. H. Byrnes, and J. J. Genson. Analyst, Vol 95, p 383-386, 1970. 3 tab, 7 ref.

Descriptors: *Analytical techniques, *Electrodes, Nitrates, Groundwater, Surface waters, Analysis, Ions, Nitrogen, Wells.
Identifiers: *Nitrate-selective ion electrode, Orion Research Corporation, Cambridge (Mass), Ion electrode, Steam distillation tests, Phenoldisulphonic acid tests, Orion Model 404, Specific meter.

The results obtained with nitrate-selective ion electrode showed no significant deviations due to interference from other ions. Recovery of nitrate nitrogen exceeded 83%, being somewhat lower in comparison with phenoldisulphonic acid and steam-distillation procedures. The electrode appears to be best suited for routine analyses of wells and surface waters having nitrate nitrogen concentrations near or above 10 milligram/liter. (Wisconsin)
W70-08105

A SIMPLE METHOD OF ASSESSING THE ANNUAL PRODUCTION OF STREAM BENTHOS,
Waterloo Univ. (Ontario). Dept. of Biology.
H. B. N. Hynes, and Mary J. Coleman.
Limnology and Oceanography, Vol 13, No 4, p 569-573, 1968. 2 tab, 12 ref.

Descriptors: *Streams, *Benthos, *Productivity, *Annual, *Methodology, Benthic fauna, Sampling, Running waters, Standing crop, Biomass, Turnovers, Invertebrates, Insects, Stoneflies, Mathematical studies, Streambeds.
Identifiers: Afon Hirnant (Wales), Speed River (Canada), Baetis vagans, Unionidae, Univoltine, Odonata, Megaloptera, Plecoptera.

The problems involved in estimating the productivity of running water are discussed. It is possible to calculate the annual production of stream benthic animals from data obtained from a series of good quantitative samples collected at intervals during the year. The method is described and its limitations and short-comings discussed. The data derived from the Afon Hirnant (Wales) used in earlier papers are reworked together with similar data from the same stream for the year 1959-1960. Standing biomass, production, and turnover ratio are calculated for both years, and the differences between the values are discussed. Figures obtained from the Afon Hirnant, an unproductive stream, are compared with those of the richer, hard-water, Speed River (Ontario) and with data obtained by Waters for Baetis vagans using the instantaneous growth rate method for estimating production. At present, this appears to be the only simple and direct method for estimating production. Because of its simplicity it could be widely applicable in obtaining approximate estimates of the turnover ratios of different types of streams. (Jones-Wisconsin)
W70-08113

7C. Evaluation, Processing and Publication

APPLICATIONS OF AIRBORNE REMOTE SENSING TECHNOLOGY,
Wisconsin Univ., Madison. Dept. of Civil Engineering.
For primary bibliographic entry see Field 07B.
W70-07649

COMPUTER DETERMINATION OF FLOW THROUGH BRIDGES,
Corps of Engineers, Davis, Calif. Hydrologic Engineering Center.
For primary bibliographic entry see Field 08B.
W70-07659

NATIONAL SYSTEM FOR WATER DATA,
Geological Survey, Washington, D.C. Water Resources Div.
For primary bibliographic entry see Field 07A.
W70-07663

THE RED SEA -- A GEOPHYSICAL BACKGROUND,
Newcastle-upon-Tyne Univ. (England). School of Physics.
R. W. Girdler.

In: Hot Brines and Recent Heavy Metal Deposits in the Red Sea, published by Springer-Verlag New York Inc, p 38-58, 1969. 21 p, 8 fig, 1 tab, 93 ref.

Descriptors: *Geophysics, *Faults (Geology), Brines Mineralogy, Hot springs, Sounding, Exploration, Geology.
Identifiers: *Red Sea, Continental movements.

The history and evolution of the Red Sea are considered in the light of the continental movement of Africa and Arabia. The relevant palaeomagnetic data pertaining to the latter are summarized. The Red Sea developed in phases, and it is likely that these correspond in time to phases of continental drift. The geophysical data for the Red Sea are summarized by considering the Red Sea in three parts; the northern Red Sea (north of 25 deg N), the central Red Sea (17 deg to 2 deg N), AND SOUTHERN Red Sea (south of 17 deg N). Structural differences from south are noted. Finally a summary is given for the evolution of the Red Sea taking into account geophysical and geological data for the whole Afro-Arabian region. (See also W70-07394) (Knapp-USGS)
W70-07681

UTILIZATION OF PHYSICAL AND MATHEMATICAL MODELS IN MARINE WATER RESOURCES RESEARCH, PLANNING AND MANAGEMENT,
Virginia Inst. of Marine Science, Gloucester Point.
For primary bibliographic entry see Field 02L.
W70-07801

FIELD SITES AND SURVEY METHODS,
Johns Hopkins Univ., Baltimore, Md. Dept. of Environmental Engineering Science.
For primary bibliographic entry see Field 05C.
W70-08123

08. ENGINEERING WORKS

8A. Structures

AIR TESTING SANITARY SEWERS,
Bloomington, Minn.; and Cherne Industrial, Inc., Hopkins, Minn.
For primary bibliographic entry see Field 05D.
W70-07715

USE OF COMPUTERS IN DESIGN OF SANITARY SEWER SYSTEMS,
Polytechnic Inst. of Brooklyn, N.Y.
For primary bibliographic entry see Field 05D.
W70-07732

DESIGN AND CONSTRUCTION OF THE WORLD'S LARGEST FLASH TYPE DESALTING PLANT AT TIJUANA, MEXICO,
For primary bibliographic entry see Field 03A.
W70-07765

EXIT GRADIENTS INTO SUBSURFACE DRAINS,
For primary bibliographic entry see Field 04A.
W70-07783

DESIGNING THE LININGS OF PRESSURE TUNNELS IN ANISOTROPIC ROCK,
V. S. Eristov.
Gidrotekhnicheskoe Stroitel'stvo, No 3, p 28-31, 1965. Transl from Russian by the Bureau of Reclamation, Trans 740, March 1970. 11 p, 3 fig, 4 ref.

Descriptors: *Tunnel linings, Anisotropy, Elastic theory, Elastic deformation, Stress, Displacements, *Structural analysis, Structural design, Tensile stress, *Foreign design practices, Rocks, *Pressure tunnels, Rock properties, *Radial stress, *Rock mechanics, Theoretical analysis, Tunnel design, Equations, *Deformation.

Identifiers: Radial loads, Rock pressures, USSR, Elastic coefficient, Formulas, Deformation restraint.

Formulas are derived for the stresses and radial deformation of a pressure tunnel lining in anisotropic rock using the theory of elasticity. The surrounding rock is assumed to be transformed into a monolithic elastic medium by grouting. Considering, with small error, only radial components of deformation and elastic resistance is possible. By using a constant coefficient of elastic resistance, the formulas are transformed into the formulas for an isotropic medium. The deformations obtained by these formulas for a thin lining coincide reasonably well with the corresponding deformations for an opening in an orthotropic medium loaded along the contour with a uniform radial load. A sample calculation is given. (USBR)
W70-07882

DESIGN OF TUNNEL SUPPORT SYSTEMS,
Illinois Univ., Urbana; and Mathews (A.A.), Inc., Arcadia, Calif.
U. D. Deere, R. B. Pack, and J. Monsees.
Paper, 49th Annual Meeting of the Highway Research Board, Washington, D.C. Jan 1970. 18 p, 1 fig, 4 tab, 10 ref.

Descriptors: *Tunnel design, *Supports, Tunnels, Excavation, Gunite, Economics, Deformation, Tunnel linings, Rock bolts, Stress-strain curves, Buckling, Disturbances, Tunneling, Tunnel construction.
Identifiers: *Tunnel supports, Rock breakage, Shotcrete, Illinois U.

Selection and design of the support system are 2 of many interrelated factors in the overall design of a serviceable and economical tunnel. The type of support, method of excavation, and character of the ground are inseparable considerations. Factors pertinent to good design of tunnel supports are: (1) types and functions of tunnel support systems; (2) types of primary support systems; (3) planning and design of tunnel support systems; (4) modern concepts of the design of tunnel support systems; (5) guidelines for selecting primary support systems for rock and soil tunnels; and (6) improvement in support systems for high-speed tunneling. Results of studies conducted at the University of Illinois on various aspects of design of support systems for transportation tunnels are described. (USBR)
W70-07890

BANK PROTECTION ON U.S. NAVIGABLE WATERWAYS,
Mississippi River Commission, Vicksburg. Channel Improvement Branch.
For primary bibliographic entry see Field 02J.
W70-07942

BANK PROTECTION OF THE MANCHESTER SHIP CANAL,
Manchester Ship Canal Co. (England).
A. E. Blyth.
Perma. Int. Asso. of Navigation Congr., XXIInd Int. Navigation Congr., Sect. 1, Subj. 6, Inland Navigation, p 157-167, Paris, 1969. 11 p, 1 map, 7 fig, 7 photo, 6 ref.

Descriptors: *Retaining walls, *Construction, Navigable waters.
Identifiers: *Manchester Canal.

The different types of revetment used along the Manchester Canal are described. The evolution in the design of these structures over the years is presented. The arrangements adopted depend on

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local conditions. These arrangements must be able to cope with efforts as a result of the lowering of the water level and the return currents. The paper describes the methods used for maintaining the structures. These methods are based on experience rather than on theoretical considerations. The paper is written in English and contains a French summary. (Grossman-Rutgers)
W70-07943

SHIP-CANAL BANK PROTECTION,
Technische Hogeschool, Delft (Netherlands).
L. Van Bendegom, J. Bouwmeester, W. Bokhoven,
P. Boer, and H. J. Span.
Perma Int Asso of Navigation Congr, XXIInd Int
Navigation Congr, Sect 1, Subj 6, Inland Navigation,
p 109-137, Paris, 1969. 29 p, 17 fig.

Descriptors: *Retaining walls, Construction materials, Costs, Navigable waters.

The protection of waterway banks must be considered as part of the general problem of the regulation of waterways at the lowest cost of construction and maintenance. Factors that influence the choice of revetment: level of water and its variations, position of the original water table and under pressures, eventual draining of the soil dimensions of the canal, dimensions and speeds of vessels and the importance of traffic. Several formulae are presented which permit the calculation of the thickness of the revetment and other important factors. Recent structures for bank protection are described. The article is written in English and includes a French summary. (Grossman-Rutgers)
W70-07944

PROTECTIVE REVETMENT OF RIVER EMBANKMENTS (IN FRENCH).
Giovanni Padoan, and Francesco Marzolo.
Perma Int Asso of Navigation Congr, XXIInd Int
Navigation Congr, Sect 1, Subj 6, Inland Navigation,
p 77-85, Paris, 1969. 9 p.

Descriptors: *Retaining walls, *Concrete-lined canals, Bank erosion.
Identifiers: *Rugosity.

Canal revetments contribute to: conservation of the canal bed, to the impermeabilization of the canal bed, and to the reduction of bank rugosity. Efforts must be made to resist erosion due to the current and to the displacement of vessels; both factors increase with the speed of vessels and with propeller wash. It must be insured that the canal bed is waterproof if it traverses permeable ground and if the original water table is at a different level from that of the canal water. New revetments such as concrete cast in site, pre-fabricated slabs and bituminous revetments are now used in addition to former types of revetments. The article is written in French and contains an English summary. (Grossman-Rutgers)
W70-07945

PRINCIPLES GOVERNING THE DESIGN AND CONSTRUCTION OF ECONOMIC REVETMENTS FOR PROTECTING THE BANKS OF RIVERS AND CANALS FOR OCEAN - AND INLAND NAVIGATION,
Ingenieur general des Ponts et Chaussees, Paris (France).
For primary bibliographic entry see Field 06A.
W70-07946

ECONOMICS OF BANK PROTECTION ON CANALS AND NavigABLE RIVERS (IN FRENCH),
Service Technique de la Direction des Ports Maritimes et des Voies Navigables (France).
R. Tenaud.
Perma Int Asso of Navigation Congr, XXIInd Int
Navigation Congr, Sect 1, Subj 6, Inland Navigation,
p 57-76, Paris, 1969. 20 p, 7 fig, 2 tab.

Descriptors: *Bank erosion, *Retaining walls, Navigable rivers, Concrete-lined canals, Navigation.
Identifiers: *Schyf formula.

The paper reviews the various factors which lead to the degradation of canal and navigable river banks. Tests carried out on scale models have shown that the amplitude of the first wave lifted at the front of the vessel is roughly double of the lowering indicated by the water level calculated by the Schyf formula. A review of the principal types of bank protection instituted in France is included. A few general rules on the use of various types of revetment are given. Protection against lapping can lead to more economical conclusions than a revetment over the entire height of the bank. The article is written in French and contains an English summary. (Grossman-Rutgers)
W70-07947

PARR V CITY OF ERLANGER (ASSESSMENTS FOR MUNICIPAL IMPROVEMENT BENEFITS).
For primary bibliographic entry see Field 06E.
W70-08017

COMMONWEALTH V DOUGHERTY (POLICY BEHIND LICENSING OF PLUMBERS).
For primary bibliographic entry see Field 05G.
W70-08063

TOWN OF PURCELLVILLE V POTTS (REASONABLE USE AND DIVERSION OF WATERS FROM A NATURAL STREAM).
For primary bibliographic entry see Field 04A.
W70-08064

8B. Hydraulics

FREE SURFACE, VELOCITY GRADIENT FLOW PAST HEMISPHERE,
Utah State Univ., Logan. Dept. of Hydraulic Engineering; Colorado State Univ., Fort Collins. Dept. of Civil Engineering; and North Dakota Univ., Grand Forks. Dept. of Civil Engineering. Gordon H. Flammer, J. Paul Tullis, and Earl S. Mason.

ASCE Proceedings, Journal of the Hydraulics Division, Vol 96, No HY7, Paper 7418, p 1485-1502, July 1970. 18 p, 10 fig, 1 tab, 10 ref, append. NSF Grant GP-2618.

Descriptors: *Open channel flow, *Flow around objects, *Flow resistance, Hydraulics, Non-uniform flow, Unsteady flow, Hydraulic models, Laboratory tests, Fluid friction, Shear drag, Viscosity, Free surfaces.
Identifiers: Flow past hemispheres.

The drag on a hemisphere in a finite-flow field with free surface effects is evaluated by successively studying six flow fields, which allows the study of one new variable at a time. These flow fields are: the semi-infinite uniform and nonuniform flow fields, the finite uniform and nonuniform flow fields without free surface effects, and the finite uniform and nonuniform flow fields with free surface effects. Three regimes of flow are defined for the hemisphere which are: (1) A regime of pronounced free surface effects, (2) a regime of moderate free surface effects, and (3) a regime of negligible free surface effects. The effect of these variables and range of conditions under which they are effective is considered. (Knapp-USGS)
W70-07657

DISTRIBUTION OF TRACTIVE FORCE IN OPEN CHANNELS,
Toronto Univ. (Ontario). Dept. of Mechanical Engineering.
Viswanathan C. Kartha, and Hans J. Leutheusser.
ASCE Proceedings, Journal of the Hydraulics Division, Vol 96, No HY7, Paper 7415, p 1469-1483, July 1970. 15 p, 7 fig, 3 tab, 12 ref, append. National Research Council of Canada Grant A-1541.

Descriptors: *Open channel flow, *Hydraulics design, *Turbulent flow, *Tractive forces, *Alluvial channels, Sediment transport, Scour, Erosion Laminar flow, Instrumentation, Hydraulic models.
Identifiers: Wall shear (Hydraulic).

The design of alluvial channels by the tractive force method requires information on the distribution of wall shear stress over the wetted perimeter of the cross section. Study was undertaken to provide details on measured shear distributions to check the validity of currently available design information. The experiments were carried out in a smooth-walled laboratory flume at various aspect ratios of the rectangular cross section. None of the present analytical techniques can be shown to provide precise details on tractive force distributions in turbulent channel flow. (Knapp-USGS)
W70-07658

COMPUTER DETERMINATION OF FLOW THROUGH BRIDGES,
Corps of Engineers, Davis, Calif. Hydrologic Engineering Center.

Bill S. Eichert, and John Peters.
ASCE Proceedings, Journal of the Hydraulics Division, Vol 96, No HY7, Paper 7412, p 1455-1468, July 1970. 14 p, 8 fig, 2 tab, 9 ref, append.

Descriptors: *Computer programs, *Flow measurement, *Bridges, Hydraulic models, Hydraulics, Open channel flow, Stage-discharge relations.
Identifiers: *U.S. Army Corps of Engineers, *Flow through bridges.

Techniques used for the computer determination of water surface profiles through bridge structures of various shapes and sizes, including culverts under high fills, are presented. Theoretical aspects of procedures using momentum principles are described in detail for both supercritical and subcritical flow. Methods for determining the controlling type of flow (low flow, pressure flow, weir flow, or various combinations of these) and corresponding changes in water surface elevation, are described and illustrated. Stress is placed on the need for additional research and field data to evaluate the accuracy of various techniques that are suited to computer determination of water surface profiles through bridges. Limitations of the procedures are described. (Knapp-USGS)
W70-07659

EFFICIENCY OF AIR-ENTRAINING VORTEX FORMATION AT WATER INTAKE,
British Columbia Univ., Vancouver. Dept. of Civil Engineering.

Michael C. Quick.
ASCE Proceedings, Journal of the Hydraulics Division, Vol 96, No HY7, Paper 7399, p 1403-1416, July 1970. 14 p, 9 fig, 10 ref, append.

Descriptors: *Vortices, *Air entrainment, *Intakes, Bubbles, Hydraulics, Flow, Hydrodynamics, Pumps, Open channel flow, Closed conduit flow, Aeration, Mixing.
Identifiers: Air-entraining vortices.

The basic mechanisms for air-entraining vortices to form at a water intake are examined and vorticity arising in boundary layers is considered in detail. Theoretical expressions are developed for calculating the maximum strength of air-entraining vortex which may form at a water intake. Experiments confirm that it is possible to calculate the strength of vortex from a knowledge of approach conditions and intake geometry. For the conditions of these tests the efficiency of vortex formation is approximately unity. A kinetic energy evaluation for the approach flow and intake flow sections indicates the organizational nature of the process and gives values for the additional pressure losses at an intake which are attributable to vortex formation. (Knapp-USGS)
W70-07662

INCEPTION AND ENTRAINMENT IN SELF-AERATED FLOWS,

Indian Inst. of Science, Bangalore. Dept. of Civil

and Hydraulic Engineering.

Thimmaiah Gangadharan, Nagar S. Lakshmana

Rao, and Kyathasandra Seetharamiah.

ASCE Proceedings, Journal of the Hydraulics Division, Vol 96, No HY7, Paper 7427, p 1549-1565,

July 1970. 17 p, 9 fig, 3 tab, 17 ref, append.

Descriptors: *Air entrainment, *Turbulent flow, *Aeration, *Open channel flow, *Air-water interfaces, Free surfaces, Boundary layers, Hydraulics.

Identifiers: Self-aerated flow.

Inception and entrainment of air in self-aerated open channel flows are studied. For inception to occur surface eddies should leave the free surface and the whole fluid should be turbulent. A criterion for the surface eddy to leave the free surface is formulated using the energy concept. A method to locate the zone of boundary layer emergence to the free surface which causes the whole fluid to be turbulent in the case of flow over free overfall spillways is developed. Using the concept of entrainment the basic equations for aerated flow down prismatic channels are formulated. Using these equations, several flow characteristics of the uniform aerated flow are studied. The investigations help in computing uniform aerated flow characteristics knowing the nonaerated flow data. (Knapp-USGS)

W70-07670

EXPERIMENT ON AN EFFLUENT DISCHARGING FROM A SLOT INTO STATIONARY OR SLOW MOVING FLUID OF GREATER DENSITY,

Hydraulics Research Station, Wallingford (England).

H. O. Anwar.

Journal of Hydraulic Research, Vol 7, No 4, p 411-431, 1969. 21 p, 8 fig, 8 ref.

Descriptors: *Mixing, *Dispersion, *Jets, *Convection, Density currents, Turbulent flow, Hydraulic models, Laboratory tests, Instrumentation, Diffusion.

Identifiers: Convection plumes.

Experiments were conducted in which fresh water was discharged upward from a slot into a stationary or a slow-moving ambient fluid, a solution of salt water of uniform density. The density at points in the plume was determined by measuring the concentration of the salt solution using an electrical conductivity probe. The profiles of density, within the range of experimental error, were of Gaussian form, close to those of a natural convection plume. The theory of a convection plume over a finite source was applied to evaluate the measured data. The measured data agreed reasonably well with the theoretical results when the origin of the plume was at the height of the potential core, which was about three times the nozzle-width. (Knapp-USGS)

W70-07672

METHODS SYSTEMIZATION MANUAL: PREPARATION OF HYDROLOGIC ENGINEERING COMPUTER PROGRAMS.

Corps of Engineers, Sacramento, Calif. Hydrologic Engineering Center.

Hydrologic Engineering Center of the Corps of Engineers, U.S. Army, U.S. Army Engineer District, Sacramento, Calif., Jan 1970. 18 p, 2 exhibits.

Descriptors: *Computer programs, *Hydrologic aspects, *Engineering, *Efficiencies, Testing, Documentation, Hydrographs.

Identifiers: Generalized computer programs, HEC.

The purpose of the manual was to provide suggestions for systemizing hydrologic engineering computer programs and to report on some programming ideas developed in HEC and at various Corps offices. Guidelines were designed to increase efficiency of computer usage and to promote easy

exchange of program routines among hydrologic engineers. The term 'generalized computer program' was adopted by the HEC as being descriptive of a kind of program which 'has application to most or all problems in a particular area of technology'. Other important aspects of the problem described were: testing, documentation, maintenance of up-to-date source decks, program distribution and assistance to users application of the programs to both simple and complex problems. An example of a highly flexible generalized program, the HEC 1 - Flood Hydrograph Package was given as an example. (Kris-Cornell)

W70-07853

VELOCITIES OF CULVERT JETS FOR INCIPIENT EROSION,

Geological Survey, Mineola, N.Y.; and Cincinnati Univ., Ohio. Dept. of Civil Engineering.

For primary bibliographic entry see Field 02J.

W70-07912

INITIAL SCOUR AND SEDIMENT MOTION DUE TO AN IMPINGING SUBMERGED JET,

Technion - Israel Inst. of Tech., Haifa.

M. Poreh, and E. Hefez.

French resume included. Proceedings 12th Congress of the International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 3 (Erosion and local scour downstream from hydraulic structures), Paper C2, p 9-16, 1967. 8 p, 10 fig, 6 ref.

Descriptors: *Scour, *Sediment transport, *Jets, Turbulent flow, Non-uniform flow, Streambeds, Shear stress, Particle size, Channels, Forecasting, Viscosity, Specific weight.

Identifiers: *Scour and sediment movement, Submerged jets.

Sediment motion and scour caused by submerged jets are difficult problems to solve by theoretical analysis. An experimental approach to study the initial sediment motion uses a circular jet that impinges normally on a flat erodible bed. The entrainment region can be analyzed using a modified form of Shield's equation for the critical shear stress. Shield's analysis is based on the assumption that the beginning of the sediment motion in a given bed is related to a particular value of the critical shear stress. The submerged specific weight of the sediment, kinematic viscosity of the fluid, and diameter of sediment particles are parameters used to define the critical shear stress. The depth of the initial scour hole was almost zero near the stagnation point and reached a maximum depth near the point of maximum shear stress. Scour is initially limited to the region where the shear stress is larger than the critical shear stress. This region of entrainment in open channels can be theoretically predicted and practical measures can be taken to protect this region. (Carstea-USGS)

W70-07913

DETERMINATION OF THE DEPTH OF SCOUR AROUND AN OBSTRUCTION IN AN ALLUVIAL CHANNEL,

Central Water and Power Research Station, Poona (India).

Z. S. Tarapore.

French resume included. Proceedings 12th Congress of the International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 3 (Erosion and local scour downstream from hydraulic structures), Paper C3, p 17-25, 1967. 9 p, 2 fig, 4 photo, 10 ref.

Descriptors: *Scour, *Alluvial channels, *Sediment transport, *Flow around objects, *Model studies, Hydraulic models, Shear stress, Sediment yield, Flow, Sediment load, Bridges, Piers, River beds, Dams, Cofferdams, Sedimentation rates.

Identifiers: *Limiting scour concept, Local scour.

Local scour occurs when the sediment transporting capacity of water at a given point is greater than the

sediment supply. This situation can occur when the sediment load is removed or when there is a local increase in shear stress, which can be caused by the presence of an obstacle in the flow. A theoretical method is given for prediction of scour around an obstruction, such as a bridge pier. The concept of limiting scour is introduced; this means the condition of the scour hole where no further erosion or deposition takes place at any point of the river bed. The following assumptions are made: (1) The theory considers the initial flow patterns in the vicinity of the obstruction; (2) The velocity diffuses into the scour hole once the scour hole develops; (3) The bed material in the section of maximum velocity rests at the angle of repose; and (4) The rate of sediment transportation between streamlines is a constant. The theoretical method was applied to determine the depth of scour around a cofferdam to be constructed for the Captain Anthony Meldahl lock and dam. There was a good agreement between calculated and observed values. (Carstea-USGS)

W70-07914

MEAN-VELOCITY CRITERION FOR SCOUR OF COARSE UNIFORM BED-MATERIAL,

Research Council of Alberta, Edmonton.

For primary bibliographic entry see Field 02J.

W70-07915

ON THE MECHANISM OF THE LOCAL SCOUR FROM FLOWS DOWNSTREAM OF AN OUTLET,

Kyoto Univ. (Japan). Disasters Prevention Research Inst.

For primary bibliographic entry see Field 02J.

W70-07916

SCOUR IN STONE BEDS,

Saskatchewan Univ., Saskatoon. Dept. of Civil Engineering; and Crippen (G. E.) and Associate Ltd., Vancouver (British Columbia).

C. D. Smith, and D. K. Strang.

French resume included. Proceedings 12th Congress of the International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 3 (Erosion and local scour downstream from hydraulic structures), Paper 68, p 65-73, 1967. 10 p, 4 fig.

Descriptors: *Scour, *Streambeds, *Weirs, *Stilling basins, Jets, Head loss, Tailwater, Flumes, Simulation analysis, Arrows, Engineering structures, Cavitation.

Identifiers: Stilling basin scour.

The energy at the base of the weir is dissipated by building a concrete apron downstream. Scour hole development and the feasibility of criteria for stone stilling basins are discussed. If drag forces of the nappe impingement exceed the existing forces, the scour hole begins to form. The drag force decreases as the hole deepens and as the velocity at the bottom of the plunging jet is reduced. The scour profile becomes stabilized when equilibrium is reached. The scour depth is a function of water head, weir length, tailwater depth, and stone properties such as size, size distribution, shape, and specific gravity. The scour depth will increase if either water head or weir height increases or as tailwater or mean stone size decreases. Flume experiments were conducted to establish relationships between the variables. The data are presented in dimensionless plots. The proposed design for building stone stilling basins was verified under a simulated natural hydrology and was found satisfactory for field use. Stone stilling basins are recommended over concrete basins because they are more economical and do not require highly skilled labor. (Carstea-USGS)

W70-07917

NOTE ON THE METHODS OF STUDY OF THE LOCAL SCOUR OF BED ROCKS ON A REDUCED MODEL,

For primary bibliographic entry see Field 02J.

Field 08—ENGINEERING WORKS

Group 8B—Hydraulics

W70-07918

THE GEOMETRICAL DEVELOPMENT AND DEVELOPMENT IN TIME OF SCOUR BENEATH A THIN SLAB,
Hydraulic Research Inst., Prague (Czechoslovakia).

For primary bibliographic entry see Field 02J.

W70-07919

CONSIDERATIONS CONCERNING SCOUR IN THE CASE OF FLOW UNDER GATES,
Technische Hochschule, Munich (West Germany).
F. Valentin.

French resume included. Proceedings 12th Congress of the International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 3 (Erosion and local scour downstream from hydraulic structures), Paper C11, p 92-96, 1967. 5 p, 2 fig, 1 tab, 5 ref.

Descriptors: *Scour, *Gates, *Sediment transport, Engineering structures, Gate control, Particle size, Dimensional analysis, Uniform flow.

Experimental work was conducted to study the scour behind a gate by using uniform flow in experiments conducted for 370 hours. The maximum depth of scour was treated according to the law of similarity. The most effective diameter of the grain used was between 0.73 and 13.5 mm. Dimensional analysis showed a good agreement between experimental data and theoretical considerations. (Carstea-USGS)
W70-07920

ON SCOUR AROUND SPUR-DIKE,
Nihon Univ., Tokyo.

For primary bibliographic entry see Field 02J.

W70-07921

SCOUR BELOW SUBMERGED SOLID BUCKET-TYPE ENERGY DISSIPATORS,
Mysore Engineering Research Station, Krishnarajaguda (India).
D. Doddiah.

French resume included. Proceedings 12th Congress of the International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 3 (Erosion and local scour downstream from hydraulic structures), Paper C13, p 105-116, 1967. 12 p, 11 fig, 1 tab, 7 ref.

Descriptors: *Scour, *Energy dissipation, *Stilling basins, *Roller gates, Engineering structures, Model studies, Flumes, Hydraulic models, Sediment transport.

Identifiers: *Submerged bucket-type energy dissipator, Scour zones, Solid roller.

The occurrence of scour below solid roller or submerged bucket energy dissipators is discussed. The submerged solid bucket is an effective energy dissipator but it requires very deep tailwater for good performance. It can be considered as a shorter stilling basin with a greater depth. The depth of scour decreases and the distance from the toe of the structure of maximum scour increases with an increase in the tailwater depth. A decrease in the radius increases scour. It appears to be no appreciable change as far as the flip action is considered. Zones of zero scour and flip action have been delineated. (Carstea-USGS)
W70-07922

SCOURS BEHIND STILLING BASINS WITH ENDILLS OF BAFFLE-PIERS,
Technische Hochschule, Brunswick (West Germany).

Friedrich Zimmermann, and Ulrich Maniak.

French summary included. Proceedings 12th Congress of the International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 3 (Erosion and local scour downstream from hydraulic structures), Paper C14, p 117-124, 1967. 8 p, 5 fig, 4 ref.

Descriptors: *Stilling basins, *Scour, *Baffles, *Piers, *Sediment transport, Energy dissipation, Streams, Waterfalls, River beds, Model studies, Hydraulic models, Hydraulic jump, Roller gates, Control structures, Stream erosion.
Identifiers: Endsills, Baffle piers.

The rate of energy dissipation in stilling basins can be judged from the nature of scour in the movable bed of a river downstream from a stilling basin or a weir. Generally, weirs with small or medium waterfall do not require any bed protection. Large size scour should be prevented at stilling basins below weirs because they may endanger structural stability. Model tests were conducted using 8 types of endsills of baffle piers in order to determine their effect upon the movable river bed behind them. The results were compared with those obtained from a flat stilling basin without any energy dissipators. The dimension of scour was reduced by more than 50% by the baffle piers. The baffle piers contributed to the stable position of the surface roller within the stilling basin. The results of the model studies are confirmed by observations. (Carstea-USGS)
W70-07923

AN INTERESTING HYDRAULIC EFFECT OCCURRING AT LOCAL SCOUR,
Hydraulic Research Inst., Prague (Czechoslovakia).

Zdenek Thomas.

French resume included. Proceedings 12th Congress of the International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 3 (Erosion and local scour downstream from hydraulic structures), Paper C15, p 125-134, 1967. 10 p, 10 fig.

Descriptors: *Scour, *Piers, *River beds, *Sediment transport, Flow around objects, Hydraulic properties, Slabs, Flow control, Erosion control.
Identifiers: *Scour at piers.

Experiments were conducted to study the effect of a horizontal shield upon the scour phenomenon at piers. The purpose of the shield was to prevent the vertical flow from reaching the river bed. A circular cylinder pier with a ring-shaped horizontal shield was used. Tests were conducted by using two shields placed at different heights above the bottom. The experimental results are expressed in dimensionless coordinates. The scour depth decreased considerably when the shield was used. Empirical equations relating the scour and the height of the shield above the bottom are given. The depth and the size of a scour can be considerably decreased by placing a thin horizontal slab near the bottom of piers. (Carstea-USGS)
W70-07924

EROSION EXPERIENCE DOWNSTREAM OF BED STABILIZATION AND WATER LEVEL CONTROL STRUCTURES,
Corps of Engineers, Omaha, Nebr.

Walter M. Linder.

French resume included. Proceedings 12th Congress of the International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 3 (Erosion and local scour downstream from hydraulic structures), Paper C16, p 135-142, 1967. 8 p, 6 fig, 1 ref.

Descriptors: *Stream erosion, *Missouri River, *Control structures, *Scour, *Bank stabilization, Water levels, Tributaries, Meanders, Channels, Flood control, Levees, Drawdown, Model studies, Bank erosion, Alluvial channels, Erosion control.
Identifiers: *Rock sills, Bed stabilization.

Tributaries to the Missouri River meandered and scoured deep channels near their mouths in order to reduce the excessive gradient near the confluence. Construction of flood control works has provided enlarged and straightened channels and levees control the water surface elevation of high flows. Without some form of water level control a severe drawdown condition and high velocities

would result in bed and bank erosion. Model tests were performed by using structures which consisted of rock sills at the mouth of the Little Sioux. The rock sills are flexible and can adjust to significant degrees of erosion that could ordinarily damage or destroy a conventional concrete structure. The rock sills should not be used as a critical depth control except for very low flows. They should be designed to operate under submerged conditions. Hydraulic model tests are important but only three-dimensional models can fully reveal the major sources of difficulty. A carefully designed and constructed rock structure can effectively control water level and prevent channel erosion. (Carstea-USGS)
W70-07925

EVOLUTION OF SCOUR DOWNSTREAM FROM A MOBILE BARRAGE RESTING ON INCOHERENT MATERIAL, AND SOME CONSIDERATIONS OF THE SCOUR MECHANISM,
State Hydraulic Works, Ankara (Turkey). Dept. of Research.

Turhan Acatay.

English summary included. Proceedings 12th Congress of the International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 3 (Erosion and local scour downstream from hydraulic structures), Paper C17, p 143-150, 1967. 8 p, 5 fig, 2 tab.

Descriptors: *Scour, *Streambeds, *Hydraulic structures, *Gates, Dams, Flow, Sediment load, Slopes, Dredging, Climatic data, Sediment transport, Agricultural watersheds, Hydraulic gates, Sedimentation, Deposition (Sediments).
Identifiers: *Scour near dams.

Local scour at Boceli small dam was investigated. The gates were closed and opened in three different ways and the effects on local scour were measured. A rapid occurrence of local scour was observed in the region with a strong flow and a high velocity. Sediment load increased considerably due to agricultural use of the upper areas with steep slopes. As a result, the bottom around the dam rose 1.70 m. About 3500 cu m were dredged from an area of 50 sq m in order to bring the bottom to the normal level. The changes in climate conditions and other natural factors in the watershed are important in designing the hydraulic works. (Carstea-USGS)
W70-07926

ANALYTICAL STUDIES ON THE EFFECT OF FRICTION AND COHESION ON FLOTATION GRADIENTS,
Punjab Univ., Chandigarh (India).

S. K. Sharma.

French resume included. Proceedings 12th Congress of the International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 3 (Erosion and local scour downstream from hydraulic structures), Paper C19, p 162-168, 1967. 7 p, 3 fig, 4 ref.

Descriptors: *Stream erosion, *Porous media, *Underseepage, *Weirs, Friction, Cohesion, Floation, Design criteria, Slopes, Streambeds, Seepage, Model studies, Tension, Gravity, Sediment transport.
Identifiers: *Flotation gradients.

The two major assumptions made during the design of weirs on permeable foundations are: (1) The downstream bed is horizontal and (2) the porous material of the bed is devoid of friction and cohesion. However, these assumptions do not hold in nature. The criteria for testing the stability of sloping beds subject to seepage were considered for noncohesive and cohesive bed materials. The generalized equations for exit of critical gradients and factor of safety were derived from model studies. In the case of noncohesive material, a particle will be lifted up when the seepage force exceeds a value just sufficient to balance the submerged weight. In the case of cohesive material, the soil

article will be lifted up when the seepage forces acting upward normal to the soil slope exceed the sum of the gravitational and tension forces acting normal to the slope in the downward direction. (Carstea-USGS)
W70-07927

MECHANISM AND COMPUTATION OF LOCAL AND GENERAL SCOUR IN NON-COHESIVE, COHESIVE SOILS AND ROCK BEDS,

For primary bibliographic entry see Field 02J.
W70-07928

A THEORETICAL AND EXPERIMENTAL STUDY OF DRAG AND LIFT FORCES ACTING ON A SPHERE RESTING ON A HYPOTHETICAL STREAMBED,
Agricultural Research Service, Oxford, Miss. Sedimentation Lab.

For primary bibliographic entry see Field 02J.

W70-07930

LOCAL SCOUR AROUND A CIRCULAR CYLINDER,

Kobe Univ. (Japan). Dept. of Civil Engineering.

Shigeru Tanaka, and Motoaki Yano.

French resume included. Proceedings 12th Congress of the International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 3 (Erosion and local scour downstream from hydraulic structures), Paper C23, p 193-201, 1967. 9 p, 5 fig.

Descriptors: *Scour, *Flow around objects, *Sediment transport, Open channel flow, Vortices, Streams, Flumes, Drill holes, Engineering structures, Flow, Channel flow, Hydraulic design, Model studies, Hydraulic models.

Identifiers: *Streambed erosion, Scour around a cylinder.

A laboratory study of local scour around a circular cylinder placed in open channel flow indicated that local bed materials were transported by vortex flow occurring at the front foot of the cylinder. The vortex is generated by a combination of main flow at the upper stream portion of the cylinder and potential flow in the downward direction along the front surface of the cylinder. The size of the local scour is related to strength and size of the vortex flow. The vortex flow could be controlled by hydraulic methods such as holes drilled through the cylinder or putting an interceptor around the cylinder surface. The size and position of the hole or interceptor were determined mainly by flume experiments. Such methods could also be applied to prevention of local scour at the front bed of vertical walls in open channel flow. (Carstea-USGS)
W70-07931

APPLICATION OF THE WALL JET THEORY TO EROSION AT THE OUTLET OF HYDRAULIC STRUCTURES,

Corps of Engineers, Mariemont, Ohio; and Cincinnati Univ., Ohio. Dept. of Civil Engineering.

Laszlo Varga, and Louis M. Laushey.

French resume included. Proceedings 12th Congress of the International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 3 (Erosion and local scour downstream from hydraulic structures), Paper C24, p 202-206, 1967. 5 p, 2 fig, 4 ref.

Descriptors: *Stream erosion, *Scour, *Hydraulic structures, *Jets, *Outlet works, Aprons, Culverts, Shear stress, Boundary layers, Pipe flow, Open channel flow, Tailwater, Streambeds, Model studies, Hydraulic models.

Identifiers: *Wall jet theory, Submerged culverts.

Erosion at the outlet of submerged culverts was studied experimentally and theoretically. Shear stresses at the inception of erosion were determined by using secondary layer theory for wall jets,

based on critical pipe velocities which initiated erosion. The critical tractive stress concept of open channel flow was found applicable to submerged jets. If the tailwater covers the top of the outlet pipe, the magnitudes of the critical exit velocity and the critical bed shearing stress are independent of the amount of submergence over the top of the outlet. The boundary layer theory can be used to predict the shearing stress along the bed and the length of protective aprons that might be required. (Carstea-USGS)
W70-07932

ON THE FLOW CHARACTERISTICS OF VORTICES IN THREE-DIMENSIONAL LOCAL SCOUR,

Waterloopkundig Laboratorium, Delft (Netherlands).

For primary bibliographic entry see Field 02J.
W70-07933

THE EFFECT OF ENTRAINED AIR ON THE SCOURING CAPACITY OF WATER JETS,

Societe Grenobloise d'Etude et d'Applications Hydrauliques (France).

For primary bibliographic entry see Field 02J.
W70-07934

THE SCOURING ENERGY OF THE MACROTURBULENT FLOW DOWNSTREAM OF A HYDRAULIC JUMP,

Technische Hochschule, Munich (West Germany). Hydraulics Research Station, Obenbach. Fritz Hartung, and Klausotto Csallner.

French summary included. Proceedings 12th Congress of the International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 3 (Erosion and local scour downstream from hydraulic structures), Paper C27, p 227-237, 1967. 11 p, 4 fig, 2 ref.

Descriptors: *Scour, *Turbulence, *Flow, *Hydraulic jump, Flow around objects, Streams, Model studies, Tractive forces, Hydraulic models, Hydraulic structures, Energy dissipation, Froude number.

Identifiers: Macroturbulent flow, *Scouring energy.

In order to obtain estimates of the range of magnitude and the distribution of the neglected macroturbulent energy in hydraulic jumps it was necessary to conduct model tests. In these tests the turbulence energy was observed indirectly by its effects on tractive force and scouring. Its order of magnitude was obtained theoretically by applying the Meyer-Peter formula for the beginning of tractive force action. Relative energy dissipation is a function of the Froude number. The energy dissipation due to the hydraulic jump is considerably smaller than estimated by means of the conventional two-dimensional analysis. The remaining surplus energy head decreases downstream of the hydraulic jump according to an exponential function. (Carstea-USGS)
W70-07935

SOME HYDRAULIC CHARACTERISTICS OF TRAPEZOIDAL DROP STRUCTURES,

Alabama Univ., Huntsville. Dept. of Fluid Mechanics; and Federal Power Commission, Washington, D.C.

Cornelius C. Shih, and Donald F. Parsons.

French resume included. Proceedings 12th Congress of the International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 3 (Erosion and local scour downstream from hydraulic structures), Paper C29, p 249-259, 1967. 11 p, 10 fig, 9 ref.

Descriptors: *Hydraulic properties, *Drops (Structures), *Weirs, Flow, Steady flow, Discharge (Water), Dimensional analysis, Channel morphology, Streambeds, Model studies, Hydraulic models, Vortices, Turbulence.

Identifiers: *Trapezoidal drop structures.

This study is concerned with some of the hydraulic characteristics of flow over drop structures connecting two trapezoidal channels at different elevations. The drop structures are formed by an abrupt drop in the horizontal channel bottom, and are equipped with or without a weir. The relationships among the quantities pertinent to the hydraulic characteristics are investigated through dimensional and experimental analyses. The dimensional analysis which was based on theoretical consideration of the flow problem, resulted in a set of dimensionless parameters, namely the relative depth, the drop number, and geometric parameters of the drop structure. Experimental results are presented in graphical form through dimensionless parameters for various trapezoidal drop structures. Some typical flow phenomena are shown in photographs. (Carstea-USGS)
W70-07936

TIME SCALE OF TWO-DIMENSIONAL LOCAL SCOUR,

Waterloopkundig Laboratorium, Delft (Netherlands).

For primary bibliographic entry see Field 02J.
W70-07937

INFLUENCE OF TIME AND HYDROGRAPH OF FLOODWATER ON THE EROSION OF ARTIFICIALLY CONTRACTED STREAM BEDS,

G. V. Zheleznyakov, L. G. Begam, and V. S. Altunin.

French resume included. Proceedings 12th Congress of the International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 3 (Erosion and local scour downstream from hydraulic structures), Paper C33, p 283-291, 1967. 9 p, 2 fig, 2 tab, 3 ref.

Descriptors: *Stream erosion, *Hydrographs, *Floods, *Streambeds, Hydraulic models, Steady flow, Unsteady flow, Cohesionless soils, Streams, Velocity, Backwater, Runoff, Discharge (Water).

Identifiers: *Artificial streambeds, Constricted flow, Lopasnya River, USSR.

The erosion of artificial streambeds was studied in hydraulic models under uniform and nonuniform flow conditions. The deformation occurring in a noncohesive bed material under steady flow was compared with that obtained with unsteady flow and with constricted streambed. Experiments in natural conditions were conducted on the small Lopasnya River near Moscow. As a result of stream constriction, the velocities became redistributed in depth and width. At the beginning of the experiments, there was a visible leveling off of longitudinal velocities along a vertical line. The relationships between the backwater before the flow constriction and the form of floodwater hydrograph are given. It was concluded that in order to compute the deformation of a constricted channel, the maximum floodwater discharge, shape of the hydrograph, duration of floodwater and the volume of the runoff should be known. (Carstea-USGS)
W70-07938

EFFECT OF FLOOD HYDROGRAPHS ON THE REGIME OF ALLUVIAL AND BOULDER STAGE RIVERS ABOVE AND BELOW CONTROL STRUCTURES,

Uttar Pradesh Irrigation Research Inst., Roorkee (India).

O. P. Gupta, S. N. Gupta, and P. N. Saxena.

French resume included. Proceedings 12th Congress of the International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 3 (Erosion and local scour downstream from hydraulic structures), Paper C34, p 292-302, 1967. 11 p, 10 fig, 1 ref.

Descriptors: *Scour, *Control structures, *Alluvial channels, *Floods, Hydrographs, Streams, Weirs, Boulders, Particle size, Slope stability, Energy dissipation, Streambeds, Stream erosion, Sediment transport, Channel morphology.

Identifiers: India, Ganga River.

Field 08—ENGINEERING WORKS

Group 8B—Hydraulics

Over one hundred years of data are presented to depict regimes of the boulder stage of the Ganga River and of the alluvial Ratmau torrent, India. A weir across the Ganga River reduced the upstream bed slope of the river from 10 ft/mile to 8 ft/mile, while the downstream slope remained unaffected for 45 years of operation. In the Ratmau torrent, the upstream slope of 8.23 ft/mile remained unchanged during 120 years of operation of the escape regulator while the downstream bed was lowered by 25 ft immediately below the control, and slope flattened to 4.15 ft/mile. A dented sill at the downstream floor of the undersluices on the Ganga was not only effective in controlling bed scour but withstood the onslaught of moving boulders 30 cm and greater diameter. Energy dissipators at the downstream floor of the escape regulator at Ratmau controlled the bed scour immediately below it but retrogression continues in the entire 9 1/4 miles length of the torrent. (Carstea-USGS) W70-07939

COMPUTATIONS ON NON-STEADY BEDLOAD-TRANSPORT BY A PSEUDO-VISCOSITY METHOD,
Waterloopkundig Laboratorium, Delft (Netherlands).
For primary bibliographic entry see Field 02J.
W70-07940

RIVER BED SCOUR AT BRIDGE CONSTRICTIONS,
Central Water and Power Research Station, Poona (India).

C. V. Gole, and S. V. Chitale.
French resume included. Proceedings 12th Congress of the International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 3 (Erosion and local scour downstream from hydraulic structures), Paper C38, p 330-337, 1967. 8 p, 5 fig, 7 ref.

Descriptors: *Scour, *Bridges, *Floods, *Engineering structures, Hydrographs, Hydrograph analysis, Rivers, Structural stability, Safety, Streambeds, Sediment transport.

Identifiers: *Scour at bridges, Constrictions.

Measurements of bed scour were made at Mokameh bridge on the Ganga River and on the Luni River at Samdari in Rajasthan, India. The rates of bed scour at these bridges were considered in relation to the flood hydrographs of the rivers. In the case of flash floods, the rate of water level rise is fast, and is not sufficient to produce scour at the bridge constriction. For structure safety on flashy rivers, the constriction should be designed to allow more waterway than is normally provided in rivers carrying sustained floods. In the case of rivers with gradual rise and fall of water (Ganga River), constrictions could be narrower because the reduction in width is compensated by an increase in depth due to bed scour. In contrast to the flashy river, the limiting depth of scour in rivers with gradual rise of water is reached by the time of the peak floods. (Carstea-USGS) W70-07941

THE STUDY OF THE SCOURS BEHIND A SPILLWAY, (IN FRENCH),
Jose Colaric, E. Pichon, and Fabien Sananes.
Proceedings 12th Congress of the International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 3 (Erosion and local scour downstream from hydraulic structures), Paper C37, p 322-329, 1967. 8 p, 7 fig.

Descriptors: *Scour, *Spillways, *Sediment transport, *Hydraulic models. Model studies, Specific weight, Particle size, Flow, Hydraulic properties, Sands, Stream erosion, Streambeds, Pressure drag, Velocity, Engineering structures.

Identifiers: *Erosion processes, Streambed scour, Sill.

The principal results of a joint research program at the Hydraulic Laboratory of Ljubljana, Yugoslavia, and the Laboratory of I.M.F.T., Toulouse, France, are summarized. The relations between hydraulic parameters such as depth of the scour, flow, chute, length and height of the flat sill, diameter and specific weight of the sand were studied at Ljubljana. At Toulouse many experiments were conducted on the scouring processes. The critical velocity of the grains dragging on the mobile bed and the pressure fluctuations were shown to be important in scouring processes. (Carstea-USGS) W70-08095

8C. Hydraulic Machinery

STREAMFLOW FORECASTING, A VITAL ELEMENT IN WATER MANAGEMENT,
Bureau of Reclamation, Salt Lake City, Utah.
For primary bibliographic entry see Field 07B.
W70-07677

DESIGN AND OPERATION OF THE FIRST DIGESTER GAS TURBINE IN THE U.S.A.,
Carollo (John) Engineers, Lafayette, Calif.
For primary bibliographic entry see Field 05D.
W70-07813

AIR ADMISSION AND FLOW AERATION IN HYDROTURBINES,
N. K. Barkov.
Elektricheskie Stantsii, No 8, p 26-29, 1968. Transl from Russian by Bureau of Reclamation, Trans No 635, Mar 1970. 17 p, 6 fig, 12 ref.

Descriptors: Foreign research, Hydraulic machinery, Surges, *Aeration, Turbine runners, *Air, Francis turbines, Kaplan turbines, Abrasion, Flow separation, Water hammer, Cavitation, Vacuum, Velocity distribution, Vibrations, *Compressed air, Fluid flow, Guide vanes, Draft tubes, Flow control, Erosion, Hydraulic design, *Hydraulic turbines, Bubbles.
Identifiers: USSR, Krasnoyarsk Powerplant USSR, *Cavitation control, *Air admission, Flow patterns, Turbine efficiency.

Various methods of atmospheric and compressed air admission in hydraulic turbines are described. Presently, atmospheric air is used successfully in hydraulic turbines for (1) filling the breaks in flow continuity, (2) preventing erratic conditions and dangerous vibration during periods of abnormal flow whirling in the draft tube, and (3) stabilizing flow for partial loading and off-design head operation. Compressed air injection is accomplished by several techniques and practical devices. Compressed air is used to reduce erosive wear in hydraulic turbines caused by cavitation. Research shows that air in flow cavities lowers significantly the rate of cavitation damage and is highly effective in controlling pressure surging beyond the turbine runner. Further study of air injection is required to improve the reliability and operation of contemporary hydromachines. (USBR) W70-07880

THE RESISTIVITY OF INSULATING OIL IN A DIRECT-VOLTAGE FIELD,
Brown, Boveri and Co. Ltd., Baden (Switzerland).
B. Ganger, and G. Maier.
Brown Boveri Review, Vol 56, No 10, p 525-533, Oct 1969. 9 p, Fig, 9 ref, append.

Descriptors: *Transformer oils, *Resistivity, *Direct current, Extra high voltage, Electric potential, Transmission (Electrical), Electrons, Conductivity, Electric insulation, *Dielectrics, Resistance, Laboratory tests, Temperature, Electric fields, Impurities.

Identifiers: *Insulating oil, Space charge, Test results, Switzerland, Foreign testing.

Insulating oil and oil-impregnated paper in various forms are the principal materials for insulating equipment found in the rectifier and inverter stations of hydro transmission systems. Depending on function and location, insulation is subjected either to a straightforward d-c voltage, or to a combination of d-c voltage and a complex a-c voltage. With an electrical series arrangement consisting of one or more layers of solid insulating materials with oil filled gaps in between, the partial voltage applied to each dielectric, in the case of d-c voltage, is solely dependent on the d-c conductances of individual materials. This conductance is defined as the ratio of leakage current to applied partial voltage. The current may also include proportions of a strongly time-dependent absorption current. Voltage distribution depends on the properties of the insulating materials used. Resistivity of new and aged transformer oil in relation to field strength was investigated almost to breakdown while varying the temperature, duration of the stress, and flow velocity. Conductivity of aged oil follows simple laws, owing to higher ion concentration, but certain anomalies are found with new oil, such as a maximum resistivity of 1 to 2 kV/mm, which can probably be attributed to space charge effects. (USBR) W70-07881

SUPERCritical BOILER UNITS, NOW IN THEIR THIRD GENERATION, GAIN TIGHTER GRIP,
Association of Electrical Engineers of the Montefiore Inst., Liege (Belgium).
Rene J. Bender.
Power, Vol 114, No 5, p 30-32, May 1970. 4 fig, 1 tab.

Descriptors: *Economic prediction, *Water pressure, Boilers, Boiler feed water, Efficiencies, Coals, Thermal pollution.
Identifiers: *Supercritical pressure, Subcritical pressure, Heat rate.

A review was made of the supercritical pressure situation to date. The first supercritical pressure boiler was built 14 years ago. Now, there are over 140 supercritical pressure units either operating, under construction, or on order in the U.S., Japan and Europe. The savings on these units go hand in hand with their efficiency. They will depend on the amount of fuel burned per year, the load factor, and the cost of fuel. Operating figures showed that the average overall heat rate for a 2400-psig plant is estimated at 9000 Btu/kWh, compared to 8860 Btu/kWh for a 3500-psig plant. This is a saving of 140 Btu/kWh or 1.6%. Further, when fuel costs are high, a supercritical operation is more economical. When fuel costs are low, a subcritical operation is more economical. The past headaches of supercritical pressure units included: (1) fouling of superheater and reheater elements; (2) leaks in the feedwater heaters; (3) starting valve leaks; (4) starting procedure; and (5) treatment of the feedwater. These problems have mostly been solved. Supercritical boiler units promise to be an important tool of the future. (Osborne-Vanderbilt) W70-08120

THERMAL EFFECTS: A REPORT ON UTILITY ACTION,
For primary bibliographic entry see Field 05C.
W70-08122

NUCLEAR POWER AND THERMAL POLLUTION: ZION, ILLINOIS,
Argonne National Lab., Ill. Radiological Physics Div.
For primary bibliographic entry see Field 05C.
W70-08130

COOLING RESERVOIR STUDY,
For primary bibliographic entry see Field 05C.
W70-08132

8D. Soil Mechanics

W70-07885

USE OF EXPLOSIVE METHODS TO COMPACT SOIL DURING CONSTRUCTION OF IRRIGATION CANALS,

A. A. Vovk, G. I. Chernyi, and B. G. Kravets.

Gidrotehnika i Melioratsiya, No 7, p 82-87, 1969.

Descriptors: Foreign research, *Explosions, Explosives, Canal seepage, Soil mechanics, *Soil compaction, *Irrigation canals, Loess, Test holes, Cohesive soils, Moisture content, Seepage losses, Unlined canals, *Canal construction, Methodology, Ponding tests, Test pits, Construction, Cost comparisons, Soil density, Testing Permeability.

Identifiers: USSR, Explosive excavation, *Construction methods, Rapid excavation, *Explosive construction, *Seepage control.

Several Ukrainian institutes conducted tests on using explosions for compacting soils to control seepage. A new method was developed using horizontal cylindrical charges instead of concentrated vertical charges. The method provided greater depth of compaction, less development of soil cracks around the crater, and a truer cross section, reducing finishing work. The method was tested in clayey loams and loessial soils under conditions similar to those encountered in building canals in the Ukraine. Seepage was measured for 2 months and again after one year by refilling craters daily and allowing for evaporation losses. Density and moisture content were measured by neutron and gamma-gamma counting in special test holes. Construction of irrigation canals in cohesive soils by explosive methods is technically and economically sound; compaction is attained 2 to 3 m beyond the canal perimeter. Construction time and use of earth-moving equipment can be reduced greatly. The new explosive construction technology will reduce seepage by 12 to 14 times; conventional explosive methods will reduce seepage by 4 to 6 times. (USBR)

W70-07883

RATION OF HORIZONTAL TO VERTICAL STRESSES FOR GRAVELS,

Bureau of Reclamation, Denver, Colo.

Willard Ellis, and R.R. Ledzian.

Report, 7th International Conference of Soil Mechanics and Foundation Engineering, Mexico City, Mexico, p 69-77, Aug 1969. 9 p, 2 fig, 2 tab, 6 ref.

Descriptors: *Gravels, Stress, *Poisson ratio, *Earth pressure, Soils, Soil engineering, Soil mechanics, Soil properties, Strain, Axial strain, Soil tests, Lateral forces, Vertical loads, Settlement (Structural), Laboratory tests, Effective stress.

Identifiers: *Deformation modulus, *At rest pressure, Soil modulus, Triaxial tests, Triaxial test chamber.

The ratio of horizontal to vertical stresses in all soils is a subject of increasing interest in soil mechanics because of the parameters needed to use the new methods of analysis, particularly the finite element procedures. The parameters needed are Poisson's ratio and modulus of deformation. A method of studying the ratio is to perform triaxial tests holding lateral strain to zero; as the vertical stress is increased, any tendency for lateral deformation is resisted by an increase in chamber pressure. The procedure is referred to as a K_{sub o} test, K_{sub o} being the notation for coefficient of earth pressure at rest. Two gravels with a maximum particle size of 3 in. were studied. Gravel A was poorly graded and free draining, and Gravel B contained considerable silty and clayey fines and was relatively impervious. Each gravel was tested at 2 gravel contents, 50 and 65%. The specimen size for all tests was 6 in. in diameter by 15 in. high. The tests were conducted under chamber pressures varying from zero to 1000 psi. The K_{sub o} values for both gravels and gravel contents were in the range of 0.2 to 0.4. The values of Poisson's ratio were the same for all tests, ranging from about 0.15 to 0.30. The values of modulus of deformation increased with increasing effective stresses. (USBR)

OBSERVATIONS ON PORE PRESSURES BENEATH THE ASH LAGOON EMBANKMENTS AT FIDDLER'S FERRY POWER STATION,

Alberta Univ., Edmonton.

Z. A. Al-Dhahir, M. F. Kennard, and N. R.

Morgenstern.

Paper 20, Conference on In-situ Investigations of Soils and Rocks, Institute of Civil Engineers, p 175-186, May 1969. 12 p, 10 fig, 1 tab, 11 ref.

Descriptors: *Pore pressure, Pore water pressures, *Embankments, Soil consolidation tests, *Earth dams, *Consolidation, Coefficients, Field tests, *Permeability, Dam foundations, Soil engineering, Soil mechanics, Piezometers, Instrumentation, Foreign research, Soil tests, Laboratory tests, Soil properties, Displacements, Settlement (Structural).

Identifiers: Embedded instruments, Permeability coefficients, Great Britain, Permeability tests, *In situ tests, Dam stability.

Fiddler's Ferry Power Station in Great Britain involved the construction of ash disposal lagoons, formed by 35-ft-high embankments, 13,500 ft long, on marsh ground adjacent to the River Mersey. The foundation for the embankments consisted of soft clay overlying peat and sand and was instrumented with piezometers. Results of observations over 5 yr are given. In situ constant heat tests were performed on 3 separate occasions at the site to obtain coefficients of consolidation and permeability and their variation with changes in effective stress. Laboratory tests underestimate the coefficients found from the tests and from the field dissipation records. Reasons for the discrepancies are given. Instability associated with a sudden rise in pore pressure was observed and is discussed. (USBR)

W70-07886

8E. Rock Mechanics and Geology

SHEAR AND SLIDING RESISTANCE TESTS OF ROCK JOINTS FOR FOREBAY DAM-GRAND COULEE THIRD POWERPLANT PROJECT,

Bureau of Reclamation, Denver, Colo.

M. L. Haverland, and G. L. Butler.

Bureau of Reclamation Report REC-OCE-70-6, Jan 1970. 28 p, 28 fig, 4 tab.

Descriptors: *Rock foundations, Strength, *Shear strength, Laboratory tests, Field tests, Grand Coulee Dam, Faults (Geology), Test procedures, *Shear tests, Rock mechanics, Foundation investigations, Granites, *Shear resistance, Cohesion, Friction, *Joints (Geology).

Identifiers: Sliding friction, *Sliding resistance, *Sliding tests, In situ tests, Rock tests, Grand Coulee Powerplant, Wash.

Shear and sliding resistance tests were conducted in the Bureau of Reclamation laboratory and at Grand Coulee Dam, Wash, on 15- by 15- by 8-in. rock blocks to determine the apparent cohesion and sliding resistance of rock joints in the area of the Forebay Dam for the Third Power-plant. Laboratory tests utilized the 5-million-pound testing machine for the normal load and a 200-ton ram for the sliding (shearing) load. The in situ tests used a cable tensioned by a 60-ton ram for a normal load and another 60-ton ram for the sliding load. Movements were measured using displacement transducers and were recorded continuously on X-Y recorders. (USBR)

W70-07870

NON-LINEAR STRESS-STRAIN RELATIONS FOR A HOMOGENEOUS SANDSTONE,

Imperial Coll. of Science and Technology, London (England).

N. R. Morgenstern, and A. L. Tamuly Phukan.

International Journal of Rock Mechanics and Mining Science, Vol 6, p 127-142, 1969. 16 p, 16 fig, 13 ref.

Descriptors: *Sandstones, *Stress-strain curves, Triaxial compression, Mechanical properties, Deformation, Bibliographies, *Rock properties, *Rock mechanics, Strength of materials, Elasticity (Mechanical), Elastic theory, Rock foundations, *Compressibility, Compression curves, Strain, Porosity, Compressive strength.

Identifiers: Triaxial tests, Foreign testing, Great Britain, Rock tests, Bulk modulus, Hysteresis loops, *Rigidity modulus.

Triaxial compression tests on a homogeneous sandstone showed nonlinear deformation, hysteresis on cyclic loading, and an irrecoverable strain on complete unloading. These properties were increased by an increase in porosity and by wetting. The sandstone has a porosity ranging from 10.0 to 16.6%. The triaxial tests were performed at confining pressures of 0, 150, and 500 psi. The nonlinearity of compressibility was greater than that of the modulus of rigidity. For specimens of a given porosity, the variation of compressibility with the sum of principal stresses was independent of loading path. Compressibility changes linearly with the logarithm of the sum of principal stresses until the value for the compressibility of quartz is reached; compressibility then remains constant. This point is reached at a unique value and is independent of porosity. At this stress level, compressibility of the sandstone is the same as quartz but the modulus of rigidity is only about one-tenth that of quartz. The simplest stress-strain relationship for describing the behavior of sandstone is one in which the modulus of rigidity remains constant, and only the modulus of compressibility varies with the average principal stress. (USBR)

W70-07888

THE NUMBER OF TEST-Pieces REQUIRED TO DETERMINE THE STRENGTH OF ROCK,

Tokyo Univ. (Japan).

U. Yamaguchi.

International Journal of Rock Mechanics and Mining Science, Vol 7, No 2, p 209-227, Mar 1970. 19 p, 26 fig, 5 tab, 3 ref, append.

Descriptors: *Rock properties, *Rock mechanics, Rocks, Mechanical properties, *Compressive strength, *Tensile strength, Statistical analysis, *Statistical methods, Statistics, Samples, *Sampling, Splitting tensile strength, *Test specimens, Test procedures.

Identifiers: Foreign testing, Japan, *Rock tests, Test results.

Investigators studying the mechanical properties of rock often find a wide scattering of values in the measurement of rock strength. Statistical procedures are useful to treat such scattered values and to compare the results. To test the validity of the statistical performance, every test specimen must be taken at random from the whole sample and enough specimens should be prepared to show the inherent probability distribution of the property of the sample. This poses the problem of how many test samples are required and how to make them. A technique from mathematical statistics is applied to several rock types to determine the number of test specimens. Compressive and tensile strengths were determined on granite, andesite, and sandy tuff, which are typical of hard, medium hard, and soft rock. As a general conclusion, 10 or more specimens are required to determine the strength of a rock, even if all specimens are prepared from the same block of rock. (USBR)

W70-07889

8F. Concrete

EFFECT OF STRESS LEVEL ON CREEP AND CREEP RECOVERY OF LEAN MASS CONCRETE,

Bureau of Reclamation, Denver, Colo.

Field 08—ENGINEERING WORKS

Group 8F—Concrete

K. B. Hickey.
Bureau of Reclamation Report REC-OCE-69-6,
Dec 1969. 12 p, 7 fig, 4 tab, 12 ref.

Descriptors: *Creep, *Elasticity (Mechanical), *Mass concrete, Stress, Concrete technology, Laboratory tests, Deformation, Concretes, Recovery, Concrete testing, Compressive strength. Identifiers: Concrete properties, Sustained loads, Compressive stress, *Creep tests, Test results, *Creep recovery.

A test program was conducted to investigate the relationship between the intensity of sustained load and the creep of a typical mass concrete with low cement content similar to that used in concrete dams. Sets of sealed mass concrete cylinders were loaded initially in compression at ages of 28 and 90 days; the loads were sustained for over a year and creep was measured periodically. Creep of concrete loaded at 28 days is proportional to sustained stress only up to 15% of the 28-day compressive strength. Increases in creep deformations are noted at stresses greater than 15%. Concrete loaded at 90 days exhibits creep proportional to sustained stress up to 22% of the 90-day compressive strength. Creep recoveries of sealed concrete specimens unloaded after 400 days of continuous compression are proportional to sustained stress, regardless of the concrete age at load application. (USBR)
W70-07871

ANALYSIS OF SHRINKAGE EFFECTS ON REINFORCED CONCRETE STRUCTURAL MEMBERS,
University Coll., London (England); and Cement and Concrete Association, London (England). Robert H. Eleverly, and Muhamet Shafi. Journal of the American Concrete Institute, Proceedings, Vol 67, No 1, p 45-52, Jan 1970. 8 p, 9 fig, 1 tab, 19 ref, append.

Descriptors: *Shrinkage, Concrete structures, *Reinforced concrete, Structural behavior, Structural design, *Structural members, Stress, Strain, Theoretical analysis, Analysis, Beams (Structural), Creep, Deformation, Deflection, Equations, Testing, Test procedures, Effects, Bibliographies, Foreign research. Identifiers: Concrete properties, Concrete slabs, Warpage, *Analytical method, Great Britain.

Concrete shrinkage often causes considerable deformation and stress changes in concrete structures; these changes are usually of sufficient importance to require attention at the design stage. A theoretical method for predicting stresses and deformations caused by concrete shrinkage is presented. Predictions of the warping behavior of reinforced-concrete beams using the method show good agreement with experimental results, particularly in the case of singly reinforced beams in which warping is most severe. Testing to verify the method is described. Previous studies of the effects of concrete shrinkage on reinforced concrete members are discussed. (USBR)
W70-07873

ALUMINUM PIPE: SOURCE OF CONCRETE-PUMPING PROBLEMS.

Concrete Construction, Vol 15, No 1 and 3, p 12-13; 94-96, Jan, Mar 1970. 5 p.

Descriptors: Low alkali cement, *Portland cements, *Pumped concrete, *Aluminum, *Pipes, Hydrogen, Concrete construction, Coarse aggregates, Aggregates, *Concrete mixes, Concretes, *Concrete technology, *Concrete placing, Bubbles, Voids, Air entrainment. Identifiers: Concrete properties, Recommendations.

Under certain conditions, concrete pumped through aluminum pipe has exhibited serious deficiencies, including reduction in compressive strength by about 50%, expansion of freshly

molded test cylinders, placement difficulties, and problems in maintaining grade after placement. Investigations show that the alkalies in cement are capable of reacting with aluminum, generating hydrogen gas that may leave voids in the hardened concrete. One report mentioned bubbles bursting at the concrete surface that could be ignited. Recommendations are made that aluminum pumplines should not be used when: (1) the coarse aggregate is quite abrasive, (2) nonuniformly graded sand is used, (3) the mix is low-slump, (4) a high-alkali cement is used, (5) a low sand-aggregate is employed, or (6) no air is entrained in the concrete. (USBR)
W70-07875

PROTECTIVE REVETMENT OF RIVER EMBANKMENTS (IN FRENCH).

For primary bibliographic entry see Field 08A.
W70-07945

ECONOMICS OF BANK PROTECTION ON CANALS AND NAVIGABLE RIVERS (IN FRENCH),

Service Technique de la Direction des Ports Maritimes et des Voies Navigables (France). For primary bibliographic entry see Field 08A.
W70-07947

8G. Materials

CAUSES AND PREVENTION OF COATINGS FAILURES,

National Association of Corrosion Engineers, Houston, Tex. A. K. Long. Material Protection, Vol 9, No 3, p 32-36, Mar 1970. 5 p.

Descriptors: *Corrosion control, *Protective coatings, *Painting, Paints, Primers (Painting), Failures, Inspection, Specifications, Steel, Maintenance, Chalking, Cracking, Chemical degradation, Deterioration, Chemical stability, Degradation, *Metal coatings, Steel structures. Identifiers: Checking, Peeling, Delamination, Rusting, Blistering, Wrinkles, *Surface preparation.

This report discusses the failure of barrier-type protective coatings applied to steel surfaces, but does not include sacrificial-type zinc-rich coatings. Coating failures may be associated with the coating itself, application of the coating, or surface preparation. Ten common types of failures are: (1) chalking; (2) color fading or color change; (3) cracking, checking, and alligatoring; (4) peeling, flaking, and delamination; (5) rusting; (6) blistering; (7) lifting and wrinkling; (8) failures from chemical or solvent attack; (9) failure around weld areas; and (10) edge failures. Remedies and methods for preventing each type of failure are given. Past experience indicates that about 70% of all coating failures result from poor surface preparation. Although the blame is placed on surface preparation, the more realistic cause may be lack of proper specifications or inadequate inspection necessary to obtain the desired results. (USBR)
W70-07872

FIBROUS POLYMERS,

University of Strathclyde, Glasgow (Scotland). R. Meredith. Contemporary Physics, Vol 11, No 1, p 43-58, Jan 1970. 16 p, 8 fig, 1 plate, 3 tab, 7 ref.

Descriptors: *Fibers, *Synthetic fibers, *Polymers, Polyethylenes, Molecular structure, Cellulose, Proteins, X-ray diffraction, Reviews, Thermal properties, Mechanical properties, Electrical properties, Rheology, Viscosity, *Materials, Foreign research.

Identifiers: Great Britain, Synthetic resins, Vinyl resins, Acrylic resins, Polypropylene, Polyamides, Polyesters.

The molecular structure and physical properties of fibrous polymers are described and examples are given of the relations between them. Most fibrous material consists of long-chain molecules of carbon, hydrogen, oxygen, and nitrogen aligned more or less parallel to each other. The most common molecular structures, the sequences of molecular building units, and cohesive forces that bind the molecules together are discussed; physical methods for investigating these structures are included. Special emphasis is given to mechanical properties and the application of mechanical vibrations for separating elastic and viscous responses. Rheological, thermal, and electrical properties and the improvement of these properties by grafting and copolymerization are covered. Some interesting uses and future developments are given. (USBR)
W70-07874

EXPERIENCE IN CONSTRUCTION OF POLYETHYLENE - CANALS,

V. A. Akopov. Gidrotekhnika i Melioratsiya, No 4, p 35-39, 1969. Transl from Russian by the Bureau of Reclamation, Trans 833, April 1970. 12 p, 6 fig.

Descriptors: *Buried membranes, Canals, Foreign construction, Canal embankments, *Canal linings, Canal seepage, Cost comparisons, Blankets, Soil compaction, Impermeable linings, *Polyethylenes, Canal design, Earth handling equipment, Economics, Joints (Connections), Foreign projects, Construction materials. Identifiers: USSR, Turkmen SSR, Polyvinyl chloride, Seepage control, Construction methods.

Several Turkmen SSR design and construction organizations developed a trench method for installing buried membrane linings in canals to prevent seepage. Using this method to install a buried polyethylene lining in a large canal in desert soil with a 40-cu m/sec discharge was basically successful but not without difficulty. The canal had an 8-m-wide bottom and 2:1 side slopes. The trench had a 22-m-wide bottom 1 m below canal grade and 0.5:1 side slopes. Herbicide was applied before lining placement. The membrane, fabricated in 2 pieces by seaming smaller sheets with a household electric iron, was laid loosely on the trench surface and seamed along the canal centerline. Earth cover was placed on the bottom, spread by bulldozers, and compacted by rubber-tired rollers immediately after membrane placement to prevent ballooning of the lining. The remaining cover material was placed in layers and compacted. Compaction of the side-slope cover was difficult because of the small working area. About a fifth of the side-slope cover sloughed in during first-year operation and was replaced; little additional sloughing occurred after saturation. Total cost was 2.98 rubles/sq m of installed lining. More extensive use of PVC linings will depend on service life and property changes. (USBR)
W70-07884

9. MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

DIRECTORY OF PERSONNEL, WATER RESOURCES IN WESTERN NEW YORK - THIRD EDITION, OCTOBER 1969. State Univ. Coll., Buffalo, N.Y. Great Lakes Lab. For primary bibliographic entry see Field 09C.
W70-07803

9B. Education (In-House)

ENGINEER VERSUS COMPUTER - A STRATEGY OF PERSUASION, California State Div. of Highways, Sacramento. For primary bibliographic entry see Field 06A.
W70-07855

C. Research Facilities

DIRECTORY OF PERSONNEL, WATER RESOURCES IN WESTERN NEW YORK - THIRD EDITION, OCTOBER 1969.

State Univ. Coll., Buffalo, N.Y. Great Lakes Lab.

Great Lakes Laboratory Publication, State University College, Buffalo, NY, 1969. 189 p.

Descriptors: *Personnel, *Water resources development, *New York, *Scientific personnel, Universities, Data collections, Research and development, Governments, Industries, Education. Identifiers: Water resources research, Directories.

A directory lists workers in water resources in western New York. The information in this directory has been separated into three divisions—subject index, personnel index and agency index. The individuals and agencies involved with a given aspect of water resources such as aquatic life or drainage are listed in the subject index. The addresses of such parties are listed in the agency index. (Knapp-USGS)
W70-07803

10. SCIENTIFIC AND TECHNICAL INFORMATION

NATIONAL SYSTEM FOR WATER DATA,
Geological Survey, Washington, D.C. Water Resources Div.

For primary bibliographic entry see Field 07A.
W70-07663

SPRINKLER IRRIGATION--A BIBLIOGRAPHY SELECTED FROM FOREIGN LITERATURE,
Department of the Interior, Washington, D.C.

Ludmilla Floss.

Bibliography Series, No 15, Office of Library Services, Washington, D.C. Feb 1970. 54 p, 251 ref.

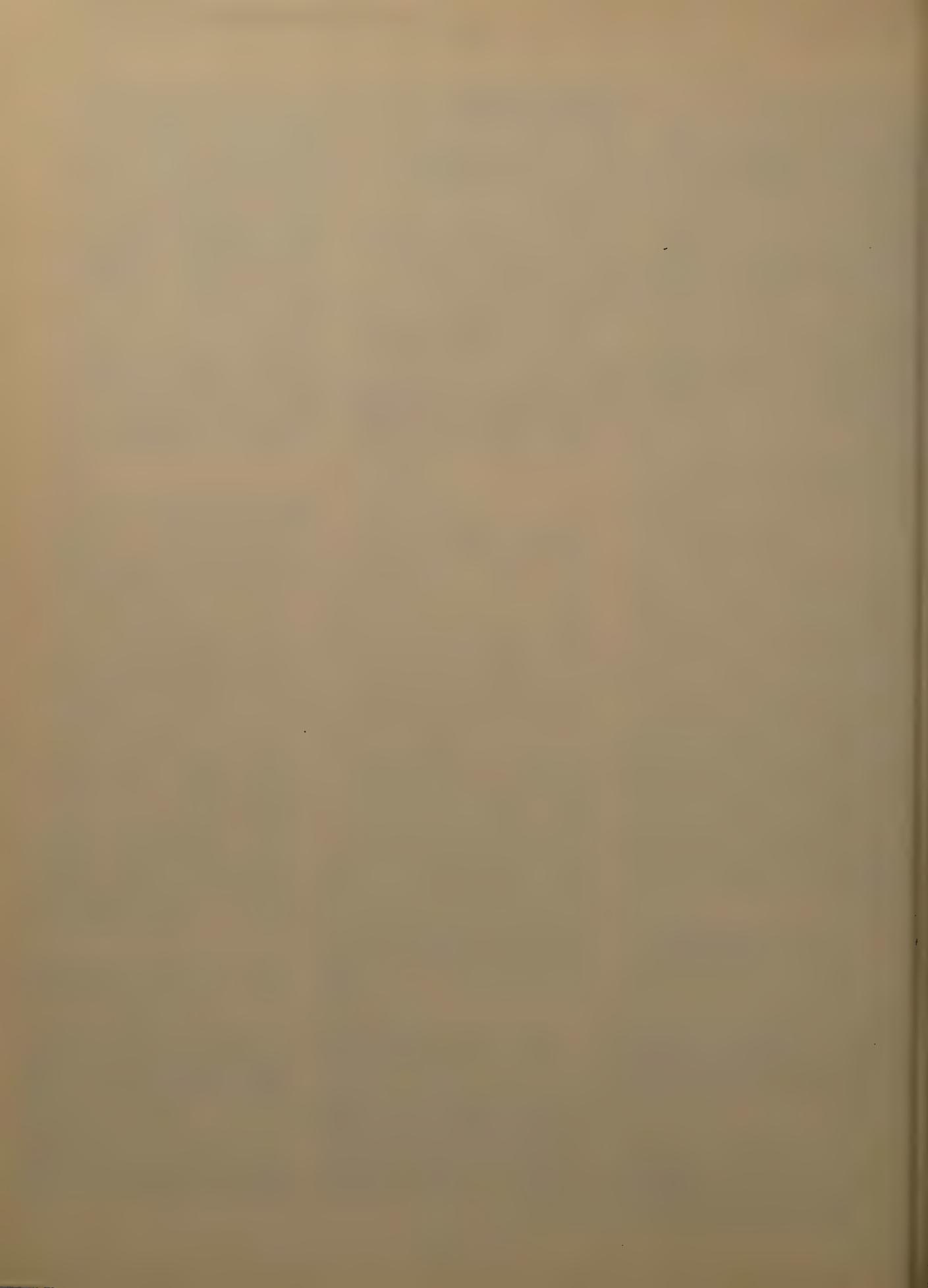
Descriptors: *Sprinkler irrigation, *Bibliographies, Foreign research, Foreign countries, Foreign design practices, Irrigation practices, Costs.

A bibliography of 251 references was compiled in response to many requests for recent foreign documents on sprinkler irrigation as distinguished from

the domestic literature which can be obtained through normal sources. Modern sprinkler irrigation has revolutionized conventional procedures and is rapidly assuming an important place in many parts of the globe. The world demand for sprinkler equipment has grown to such great proportions that advanced studies in perfecting constructional solutions of such equipment are underway. Included in the bibliography are references to costs and economy of operation, equipment and systems of installation, and stationary and mobile methods of sprinkler irrigation; agricultural aspects have not been included. The references listed, with only a few exceptions, are from 1964 through summer 1969. The format is by country of publication, with an index of authors and names of organizations and government bodies concerned. A list of abbreviations used in the citations follows the bibliography. (USBR)
W70-07879

STATE OF THE ART REVIEW ON PRODUCT RECOVERY.

Resource Engineering Associates, Wilton, Conn.
For primary bibliographic entry see Field 05D.
W70-07997



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70-07820	05D	W70-08000	04A
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70-07856	04A	W70-08008	06E
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70-08040	04A	W70-08030	04A
DI NARDO V EO VIDIO (RIGHT OF DRAINAGE THROUGH ARTIFICIAL DITCH ON ANOTHER'S LAND).		HONEY V BERTIG (CASTING FLOOD WATER ON ADJACENT LANDS).	
70-08075	04A	W70-08042	04A
LOUISVILLE AND NASHVILLE RR V CAPDEPON (DUTY TO REMOVE OBSTRUCTION TO NATURAL FLOW OF SURFACE WATERS).		JOHANNSEN V OTTO (DRAINAGE FLOW ACROSS ADJACENT LAND INCREASED BY ARTIFICIAL DRAINAGE SYSTEM).	
70-08116	04A	W70-08043	04A
DIVERSION TACKETT V LINNENBRINK (RIGHT TO DIVERT SURFACE WATERS).		SMITH V ORBEN (INCREASED WATER FLOW IN STREAM).	
70-08065	04A	W70-08052	04A
GROBART V PASSAIC VALLEY WATER COMM'N (PREScriptive RIGHTS TO DIVERT WATER).		DRAINAGE WATER CITY OF PERU V CITY OF LA SALLE (RIGHT TO HAVE SURFACE WATERS NATURALLY DISCHARGED).	
70-08085	06E	W70-07999	04A
GROBART V PASSAIC VALLEY WATER COMM'N (PREScriptive RIGHT TO DIVERT WATER--COMPUTATION OF ALLOWABLE DIVERSION AMOUNT).		DRAINAGE WELLS THE DETERMINATION OF THE DRAINAGE FACTOR AS A CRITERION FOR THE SOILS OF THE INDUS PLAINS.	
70-08086	06E	W70-07794	04A
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70-08047	04A	W70-08076	06E
DIVERSION STRUCTURES CAVANAUGH V TEXAS DISTRIBUTING CO (ARTIFICIAL COLLECTION AND DISCHARGE OF WATER LIABILITY FOR ICE FORMATION).		DREDGING PETROVICH V UNITED STATES (SUIT FOR DAMAGES TO OYSTER BEDS ARISING FROM CHANNEL DREDGING).	

W70-08013	04A	W70-07866	06E
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W70-07936		W70-07867	
DRUGHT AVOIDANCE DROUGHT RESISTANCE OF MONTEREY PINE NEEDLES.	02I	MCDONALD V SARGENT (DESTRUCTION OF PRESCRIPTIVE EASEMENT).	
W70-07780		NONUSER).	
DRUGHT RESISTANCE DROUGHT RESISTANCE OF MONTEREY PINE NEEDLES,	02I	W70-07910	06E
W70-07780		FAIRWOOD BLUFFS CONSERVANCY DISTRICT V IMEL (DISCHARGE OF RAW SEWAGE INTO OPEN DITCH).	
DRUGHT TOLERANCE CARBON DIOXIDE EXCHANGE OF SEEDLING PINES IN THE LABORATORY AS RELATED TO LOWER ELEVATION LIMITS,	02I	W70-07998	05G
W70-07764		MORRIS V TOWNSEND (SUITE TO ACQUIRE USE OF ARTIFICIAL LAKES NON-RIPARIAN OWNER).	
GENETIC VARIABILITY IN ROOT DEVELOPMENT IN RELATION TO DROUGHT TOLERANCE IN SPRING WHEATS,	3F	W70-08005	06E
W70-07785		PADDOCK V TOWN OF DURHAM (DAMAGES FROM TEMPORARY EASEMENT FOR SEWER CONSTRUCTION).	
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W70-07796		TOWN OF HAMBURG V GERVASI (PRESCRIPTIVE EASEMENTS SURFACE WATER).	
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W70-07787		FREIDEN V WESTERN BANK AND TRUST CO (SEWERS PRESCRIPTIVE EASEMENTS).	
DUST DOME THE CLIMATE OF CITIES.	02B	W70-08023	04A
W70-08121		WHEELER V TAYLOR (RIGHTS TO CONTINUED WATER FLOW).	
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W70-08100		GREAT HILL LAKE, INC V CASWELL (PRESCRIPTIVE RIGHTS OF LAND OWNERS IN ARTIFICIAL LAKES).	
DYEHOUSE WASTES STUDY OF WASTE WATER FROM DYEWORKS (IN FRENCH),	05D	W70-08038	06E
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